CHAPTER 1
INTRODUCTION

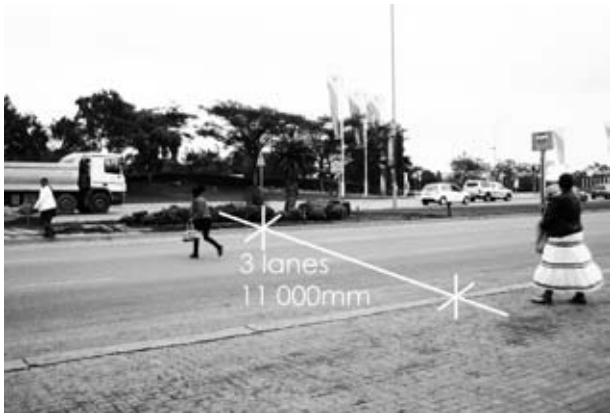
1. INTRODUCTION

In the metropolitan area of Tshwane commuters and inhabitants rely on, and make use of, formal and informal public transport. Motor vehicles are used by approximately 30% of Tshwane's population while the remainder of the population make use of public transport (Department of Transport, 2007: 22).

With such a high percentage of the population making use of public transport, Tshwane's urban infrastructure should accommodate and encourage the use of public transport. However, a lack of public transportation and pedestrian facilities is apparent (City Planning Committee, 2002: [10]).

The National Land Transport Transition Act of 2000 (Government Gazette, 2000: 20) directs government to actively promote public transport. The Gautrain Rapid Rail Link is an integrated government project that aims at promoting public transport and contributing to a province that is more conducive to public transport and the transfer from one public transport mode to the other (Gautrain, 2011c).

ILLUS. 1.3: Taxis on sidewalk of Atterbury Road.



ILLUS. 1.4: Pedestrians jaywalking on Atterbury Road.

Project specifications

Client:

City of Tshwane

Site:

Erf Number 69, Menlyn

Programme:

Intermodal Transport Exchange

GPS Coordinates:

-25°47'6.12"S, 28°16'49.79"E

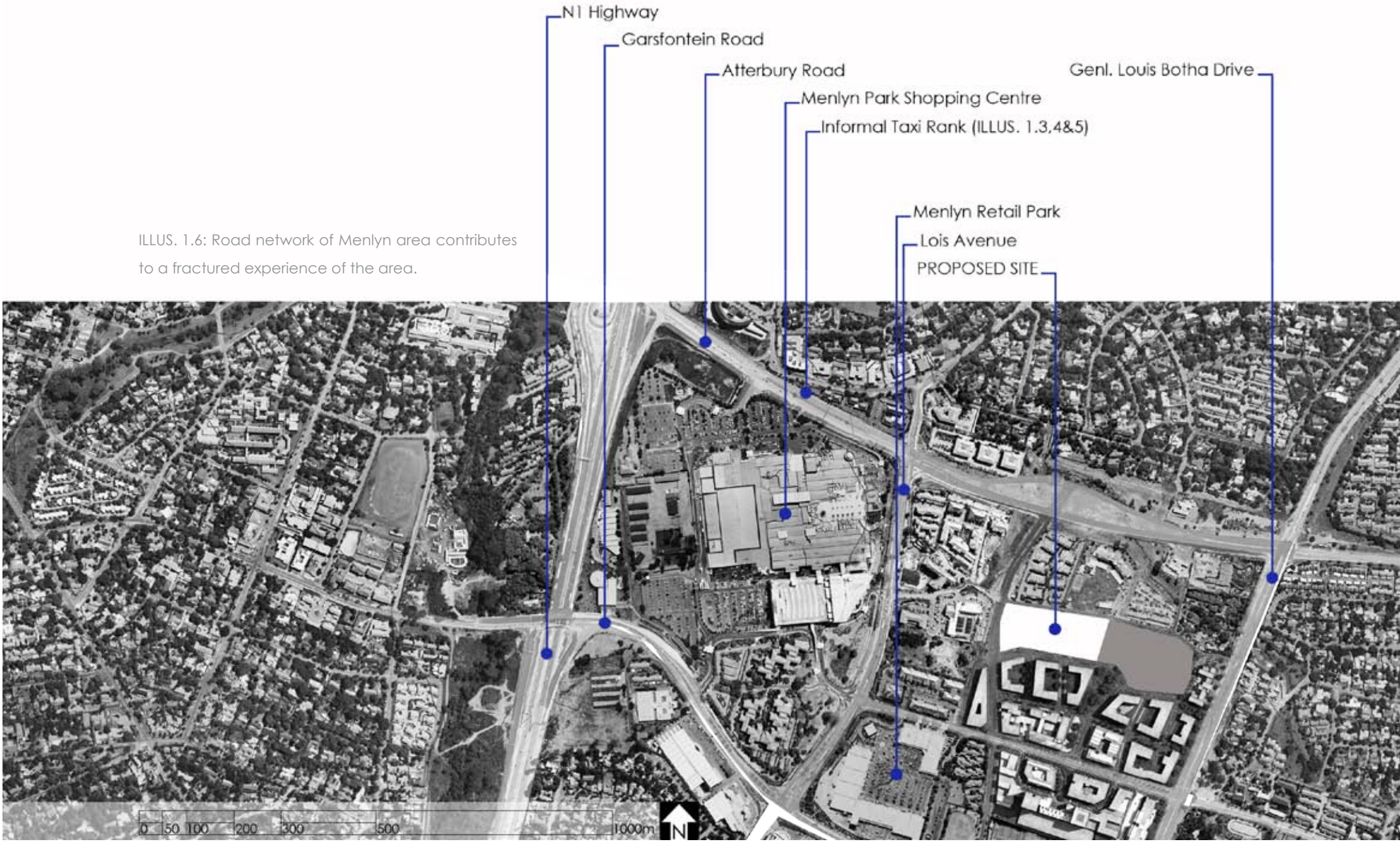
1.1 PROBLEM STATEMENT

According to the City Planning Committee (2002: 3), major transportation and land use problems are experienced in the Menlyn precinct in Tshwane. Current infrastructure allows motor vehicles to dominate public transport and pedestrian thoroughfare. Pedestrians and motor vehicles are placed in danger and traffic problems are created when taxis and buses make use of road lanes and sidewalks to stop (illus. 1.3-5). The interaction and superposition of these problems are manifested as a fracture in the urban framework, disconnecting people, environments and different transport modes from one another and the rest of Tshwane.

1.2 BRIDGING THE FRACT[URE]

The aim of this project is to address the fractured experience in the Menlyn area with the design of a Gautrain Platform Building at Menlyn. This Gautrain Platform Building should form part of an intermodal transport exchange. The project should respond to the poor connectivity and transport problems currently experienced in Menlyn and reinforce Menlyn as an important node within Tshwane. The project will not only address the functional aspects of a Gautrain Platform Building, but will also apply theories of thought that will contribute to the design concept and final design.

ILLUS. 1.5: Bus shelter on Atterbury Road.



ILLUS. 1.6: Road network of Menlyn area contributes to a fractured experience of the area.

1.3. HYPOTHESIS

A Platform Building at Menlyn could integrate the various transport systems present in the Menlyn precinct with the envisioned Gautrain station.

1.4 LITERATURE

The literature studied focuses on intermodal transport exchanges and indicates that the design of transport exchanges spans across different disciplines and scales. Urban designers, architects, landscape architects and transport engineers have contributed to the understanding and design of intermodal transport exchanges. Design interventions range from urban frameworks, for example Los Angeles Gateway Center (1995) by The Olin Partnership and Fong & Associates in the USA (illus. 7-8) (Thompson, 1997: 110), to a series of bus shelters, as in Dundee's Central Bus Exchange (2004) by Nicoll Russell Studios in England (illus. 9-10) (Evans, 2005: 34). Transport exchanges are often approached from a pragmatic point of view, engineering principles are employed that do not necessarily address the problem with architectural depth and innovative ideas.

Zaha Hadid's completed design for the suburban transport interchange, Terminus Hoenheim-Nord (2001) (illus. 11-12) in Strasbourg serves as an example where innovative architecture and pragmatic requirements meet (Giovannini, 2001: 136). The design "dissolves the distinction between art and architecture" (Fairs, 2001: 40) and clearly illustrates the concept of intersecting force fields.

ILLUS. 1.7; Entrance to Union Station at Los Angeles' Gateway Center.

ILLUS. 1.8: Aerial photograph of Gateway Center.

ILLUS. 1.9: Bus Stop at Dundee Central Bus Exchange.

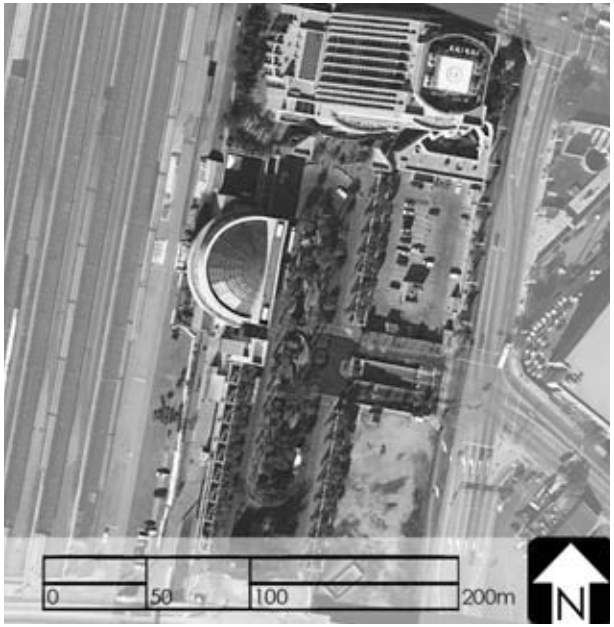
ILLUS. 1.10: Aerial photograph of Dundee Central Bus Exchange.

ILLUS. 1.11: Hoenheim-Nord Station.

ILLUS. 1.12: Aerial photograph of Hoenheim-Nord Station.

ILLUS. 1.7:

ILLUS. 1.8



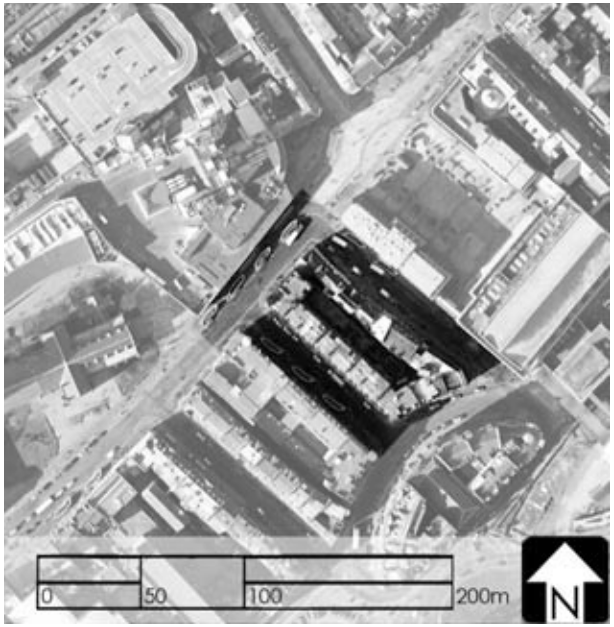
Los Angeles Gateway Centre

Programme: Intermodal transportation hub

Capacity: 1 500 busses/day, 3 000 motor vehicle parking bays; **No. of users per day**: 115 000

ILLUS. 1.9

ILLUS. 1.10



Dundee Central Bus Exchange

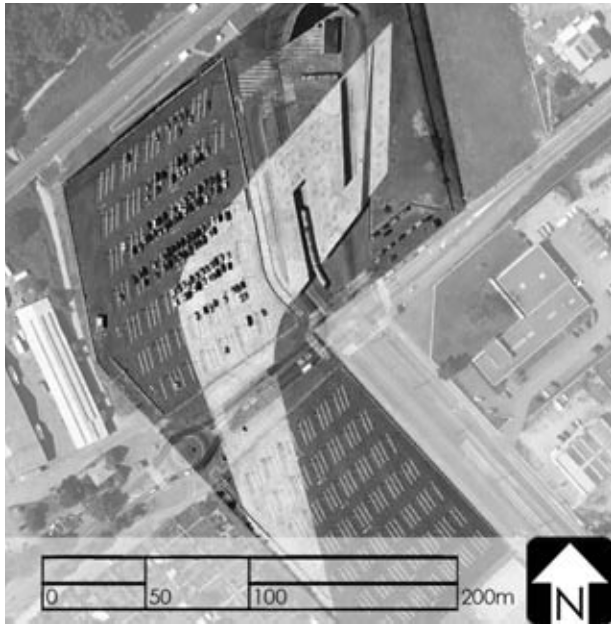
Programme: Bus exchange

Capacity: 12 bus stops

No. of users per day: 12 000

ILLUS. 1.11

ILLUS. 1.12



Hoenheim-Nord Station

Programme: Intermodal transport terminus

Capacity: 700 motor vehicle parking bays

No. of users per day: 50 000

1.5 METHODOLOGY

1.5.1 RESEARCH METHODOLOGY

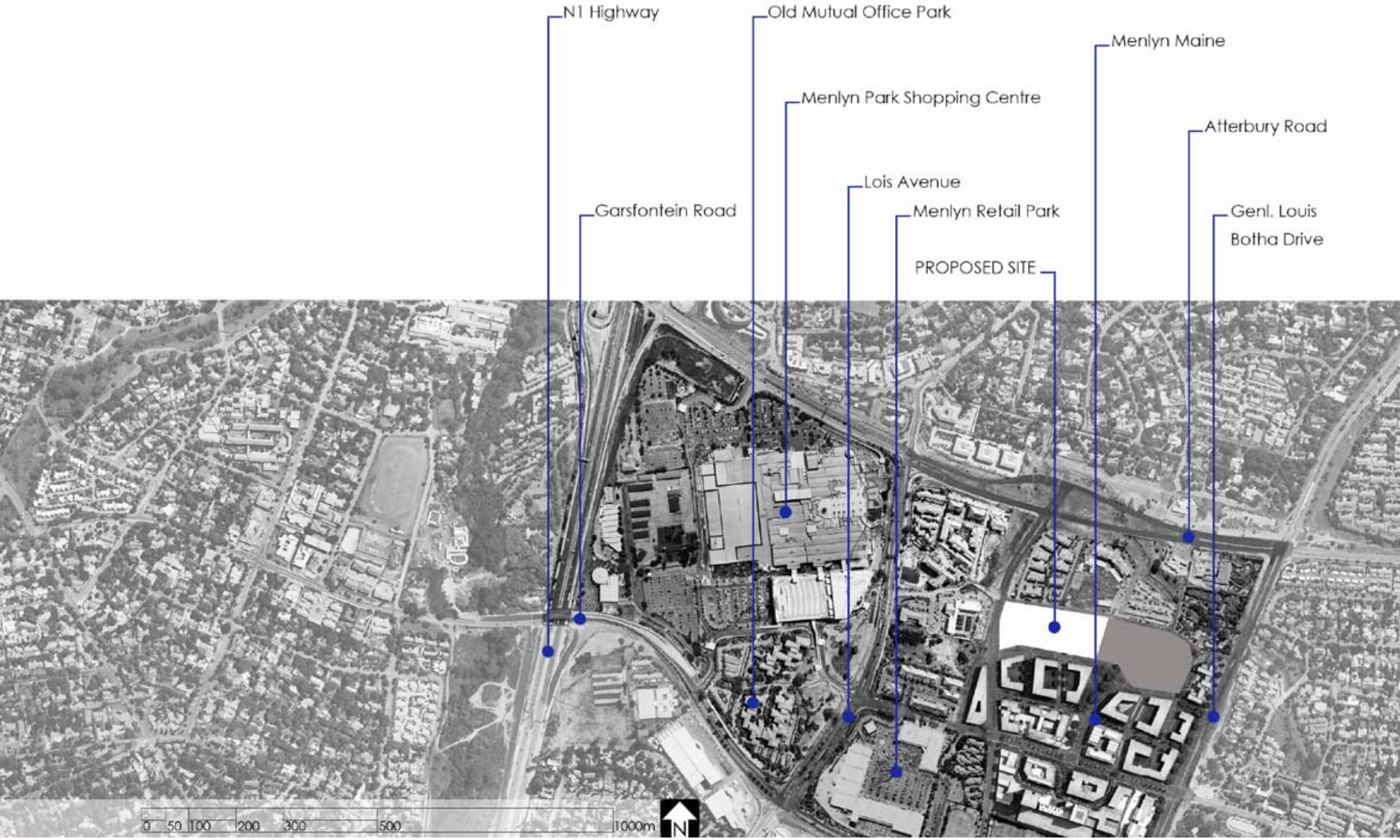
- Investigate current transport system (with focus on the Menlyn precinct).
- Identify key issues and shortcomings surrounding accessibility and connectivity within the Menlyn precinct.
- Develop a theoretical approach.
- Investigate relevant precedents, literature and solutions.
- Use and apply information that was collected to propose a final design solution.

1.5.2 DELIMITATIONS

The following delimitations will be applied to the study and final design:

- The site of the Menlyn Gautrain Station is within the boundaries formed by Atterbury Road, Genl. Louis Botha Drive, Garsfontein Road and Lois Avenue.
- The envisioned underground Gautrain station will exit into the Platform Building at Menlyn.
- The Menlyn Maine development is accepted as part of the urban framework (and is considered complete and functioning).
- For the purpose of the investigation, pedestrians will be regarded as a mode of transport.

ILLUS. 1.13: Context plan. (Opposite)



CHAPTER 2
REVIEW & REASONING

In this chapter the functioning of transportation in the Menlyn precinct will be reviewed. The reasoning behind this dissertation will also be presented as motivation for the architectural design response that follows.

2.1 BACKGROUND

The layout of the city of Tshwane includes numerous suburbs, many of which are located on the outskirts of the city. According to Atash (1996: 39) this layout leads to the decentralisation of the residential households. This decentralisation is inherently pursued by various retailers and other employers, leading to the forming of multiple nodes within a city.

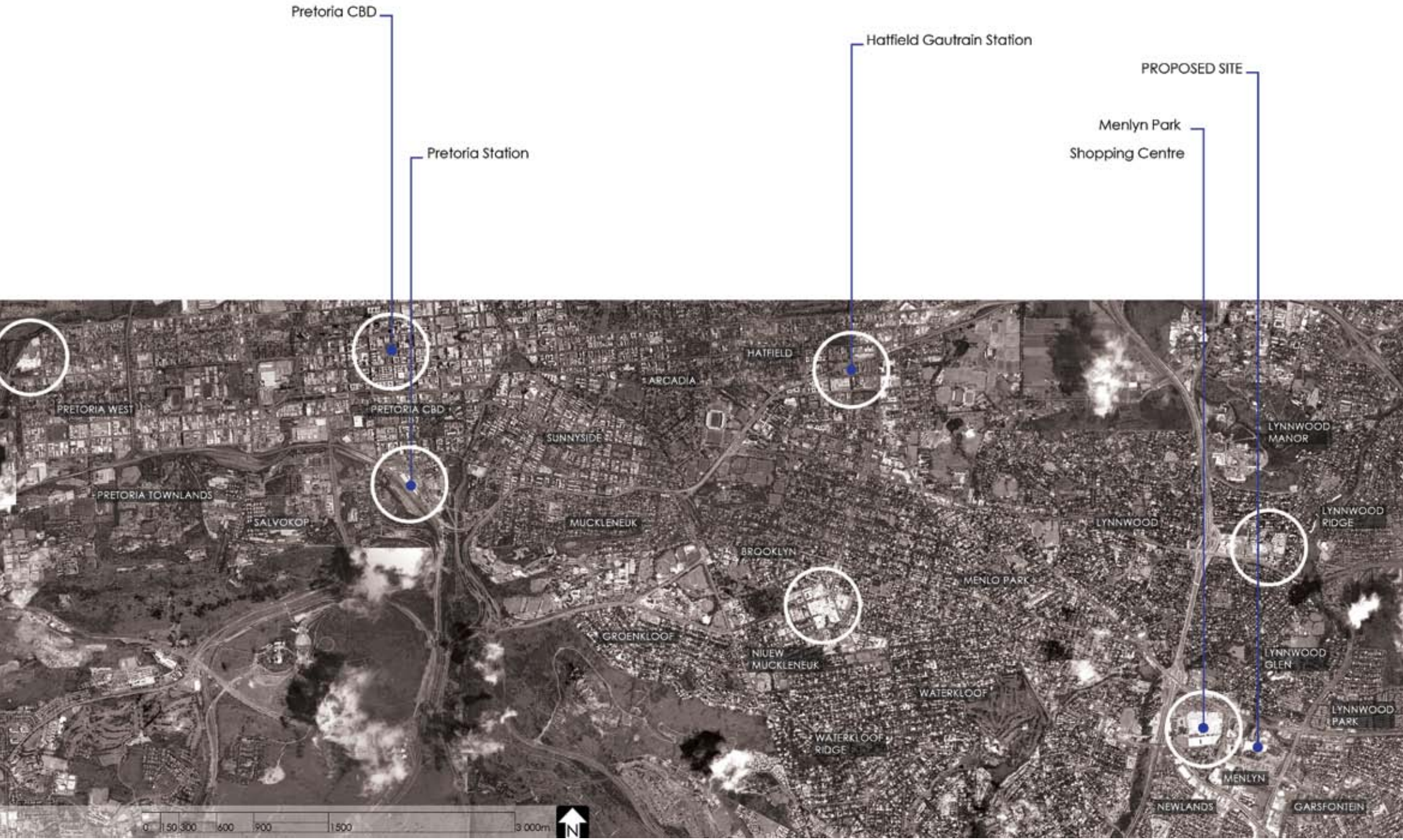
One of Tshwane's nodes is located in the Menlyn precinct, situated in Pretoria East (illus. 2.1). The Menlyn Park Shopping Centre, located next to the N1 highway, forms the main attractor of this commercial node. The study takes the area's existing commercial and business functions as well as the neighbouring residential areas into consideration.

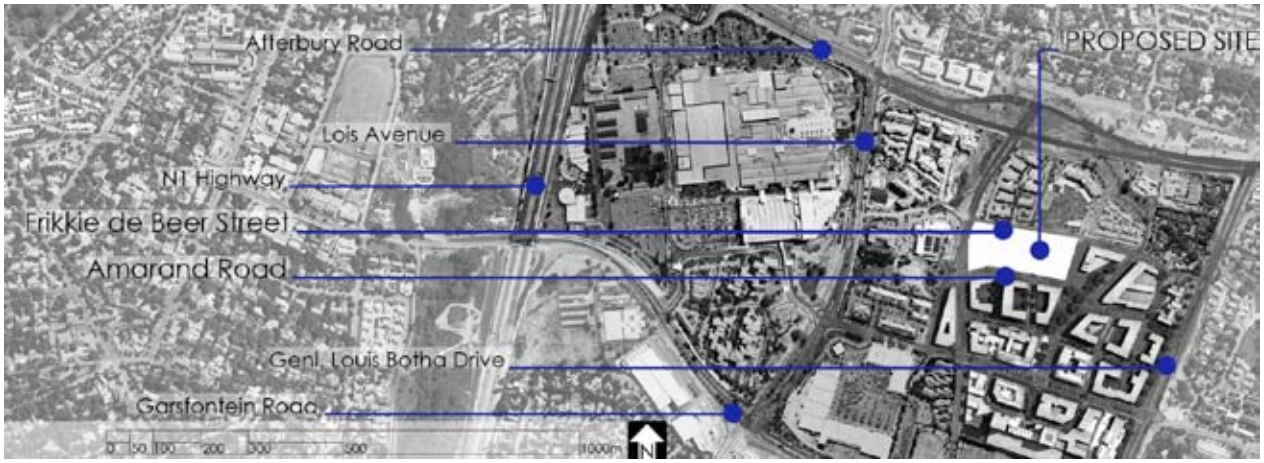
ILLUS. 2.1: Greater context indicating urban nodes, stations and surrounding suburbs. (Opposite) .

Menlyn Park Shopping Centre

Date of opening: 1979, refurbished 1998
No. of visitors:
1,5 million monthly
No. of parking bays:
3 135 covered bays
2 088 open bays
5 223 total
No. of shops:
273
Gross Letable Area (GLA):
118 253m²
Unique Selling Points:
Outdoor events arena, play park, rooftop drive-in

(Mallguide.co.za, 2008)


Pretoria CBD
Pretoria Station
Hatfield Gautrain Station
PROPOSED SITE
Menlyn Park
Shopping Centre
PRETORIA WEST
PRETORIA CBD
ARCADIA
HATFIELD
SUNNYSIDE
PRETORIA TOWNLANDS
SALVOKOP
MUCKLENEUK
BROOKLYN
MENLO PARK
LYNNWOOD
LYNNWOOD MANOR
LYNNWOOD RIDGE
GROENKLOOF
NIUEW MUCKLENEUK
WATERKLOOF
WATERKLOOF RIDGE
LYNNWOOD GLEN
LYNNWOOD PARK
MENLYN
NEWLANDS
GARSFONTEIN
0 150 300 600 900 1500 3 000m
N



ILLUS. 2.2: Location of proposed site. (Left)
ILLUS. 2.3: Plan of Menlyn precinct indicating walking radii from site, existing transport and the location of the future Menlyn Gautrain Station. (Opposite) .

2.1.1 CONTEXT

The proposed site is situated in the Menlyn precinct (Pretoria East). Frikkie de Beer Street and Amarand Road form the Northern and Southern site boundaries (illus. 2.2). The site forms part of an urban framework for the block bounded by Atterbury Road, Genl. Louis Botha Drive, Garsfontein Road and Lois Avenue.

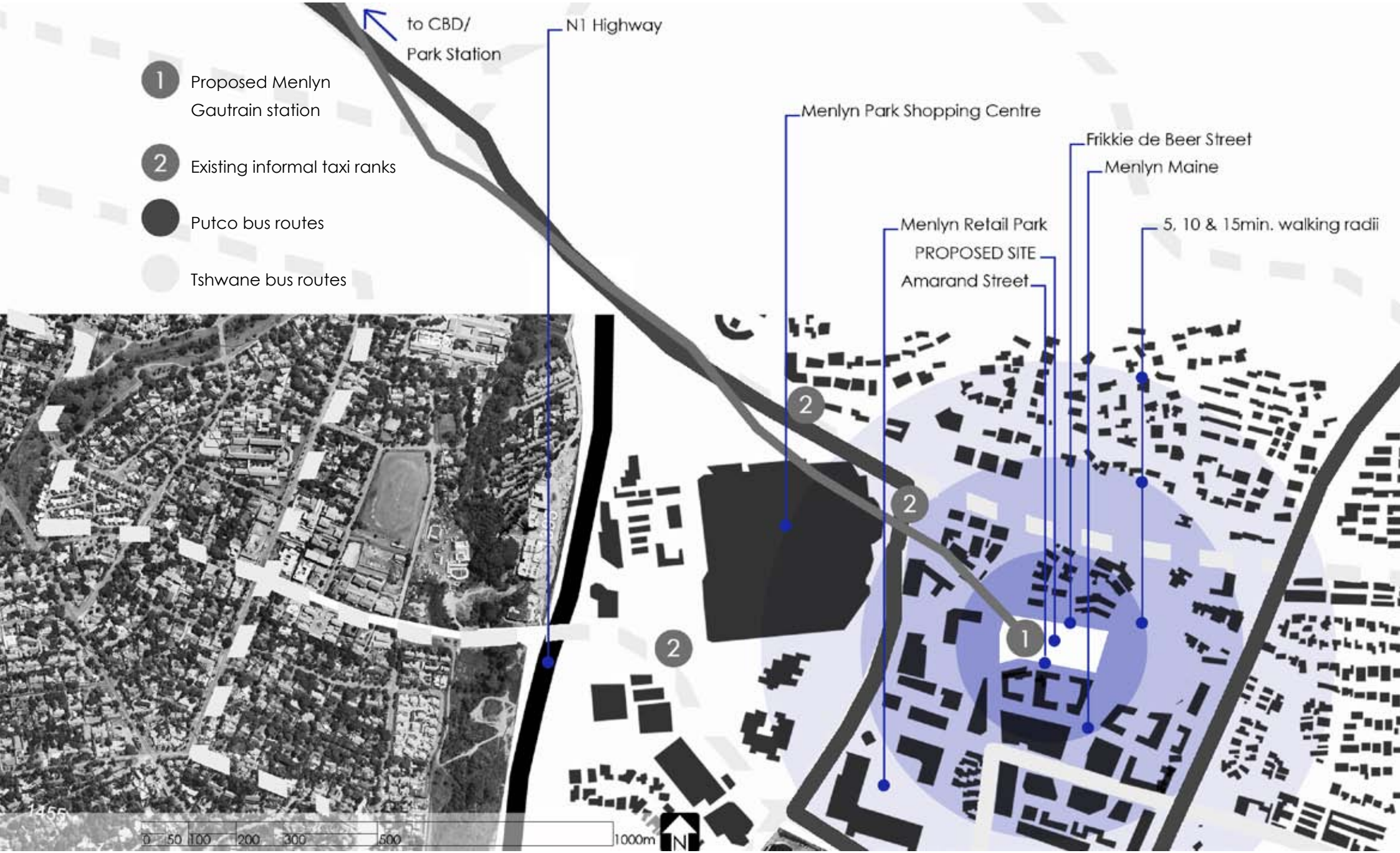
The site is in close proximity (15 minute walking distance) of the following existing facilities/uses:

- Menlyn Park Shopping Centre, one of the region's biggest shopping centres.
- Menlyn Retail Park, a retail centre.
- Menlyn Maine, a mixed-use Green Star SA certified lifestyle development.
- Residential Neighbourhoods.
- Educational Facilities - The Glen High School and Damelin College.

Within the Gautrain development framework, the Menlyn precinct has been identified as the location of a station for the extension of the Gautrain Rapid Rail Link (Gautrain, 2011a). In addition, Menlyn is the location of various informal taxi ranks, has multiple bus routes traversing the area and is close to the N1 highway.

-

Urban Node: Lynch (1975: 47) describes nodes as strategic spots within a city to and from where people travel. Nodes are also described as concentrations of important functions.
Nodecity.com (S.a) indicates that a node is a meeting point of a group or collection of things.
In transportation terms, van der Laan (1998: 239) argues that a node is identified where a high level of incoming and outgoing commuting takes place.
For the purpose of this dissertation a node will be regarded as a concentration of important urban functions (employment, retail and transport). This concentration overlaps with a (wider) point to and from which people commute on a daily basis.



City block characteristics				
City	**Length (m)**	**Width (m)**	**Accessible by public transport**	**Accessible by train**
Cape Town CBD	80	70	Yes	Metrorail
Durban CBD	200	100	Yes	Metrorail
Johannesburg CBD	70	70	Yes	Metrorail
Menlyn Precinct	800	800	Yes	No
New York CBD	120	60	Yes	Subway
Tshwane CBD (Pretoria)	230	150	Yes	Metrorail

TABLE 2.1: Comparison of city block sizes, accessibility and users. (Author, 2011)

ILLUS. 2.4: Comparison of existing street layouts for Pretoria CBD (grid) and Menlyn precinct (free flowing). (Opposite)

2.1.2 THE INFLUENCE OF THE MOTOR VEHICLE ON CITY LAYOUT

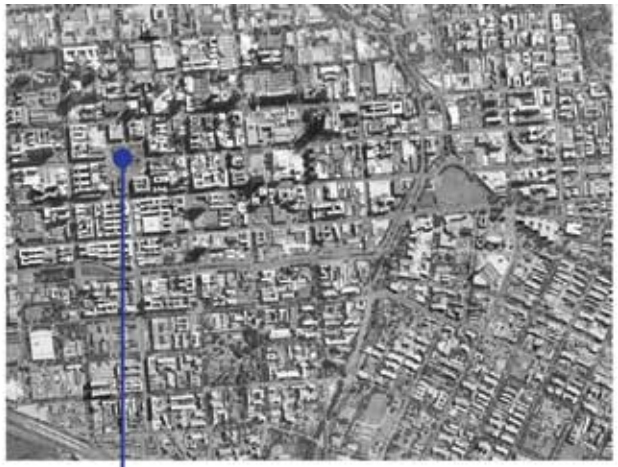
The motor vehicle is one of the most important inventions of the 19th century (Parrack, 2010). It has become a part of everyday life and has changed the shape of our cities, including Pretoria. This however should not be confused with private car ownership.

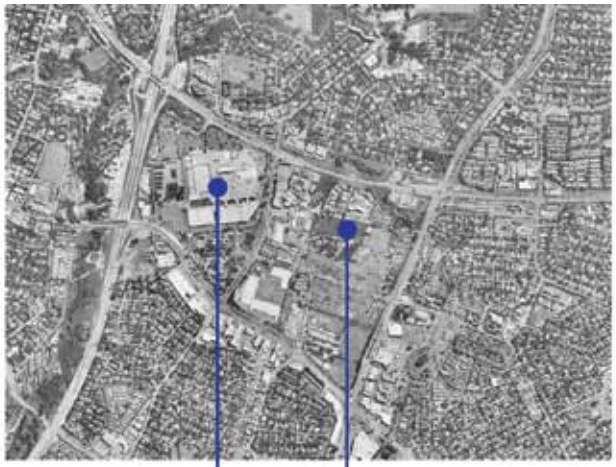
Before the 1950's, when highways were first introduced, cities were structured and planned with the CBD (Central Business District) as focal point. Inhabitants of the city made use of public transport to travel to and from the CBD. Suburbs were located close to the CBD and were linked to the public transport system. The Pretoria CBD illustrates this with a grid layout that is immediately surrounded by suburbs that are easily served by public transport (Pretorius, 2000: [9]).

The 1960's were characterised by a preference for the private motor vehicle. Private vehicle ownership along with the introduction of highways led to the creation of suburbs further afield, such as Menlyn. These suburbs' layouts were done with private motor vehicles in mind (ibid.). This resulted in free-flowing street layouts, which does not encourage effective integration of public transport (illus. 2.4).

2.1.3 ESTABLISHMENT OF MENLYN AS A NODE

The implementation of the N1 highway during the 1960's enabled the birth of new suburbs further away from the Pretoria CBD. These new suburbs were in need of a commercial entity in close proximity and led to the approval of the Menlyn Hyperama retail outlet, now Menlyn Park Shopping Centre. This new shopping centre initiated Menlyn as a new development node within Pretoria (City Planning Committee, 2002: 3).





Menlyn Park
Shopping Centre

Church Square

Church Square
(grid layout)

Menlyn Park
Shopping Centre
(free-flowing layout)

PROPOSED SITE

0 125 250 500 750 1 250m

N

Jaywalking: Term used for illegally crossing a road at a point other than an intersection or pedestrian crossing (Walkinginfo.org, 2007; Ntholeng, 2011).

ILLUS. 2.5: Route to pedestrian stairway.

ILLUS. 2.6: Sidewalk obstructed by infrastructure.

2.1.4 MODES OF TRANSPORT

The modes of transport that will be included in the Menlyn Intermodal Transport Exchange, of which the Gautrain Platform Building at Menlyn forms part, are:

- Pedestrian
- Motor vehicle
- Taxi
- Bus
- Gautrain

A brief description of each of these modes will be presented next.

PEDESTRIAN

The Menlyn node was developed during an era characterised by a distinct bias favouring the motor vehicle (Pretorius, 2000: [9]). Although it is possible for pedestrians to navigate the area, the effect of this bias was to exclude and disregard the role of the pedestrian in the design and development of the area. It is common for pedestrians to jaywalk. This is a direct contribution to the number of road accidents in Gauteng (Department of Transport, 2009: 30).

To gain direct insight into the factors contributing to the experience a pedestrian may have of the area, the Menlyn precinct was navigated on foot by the author. A summary of this exercise is shown in illus. 2.11.

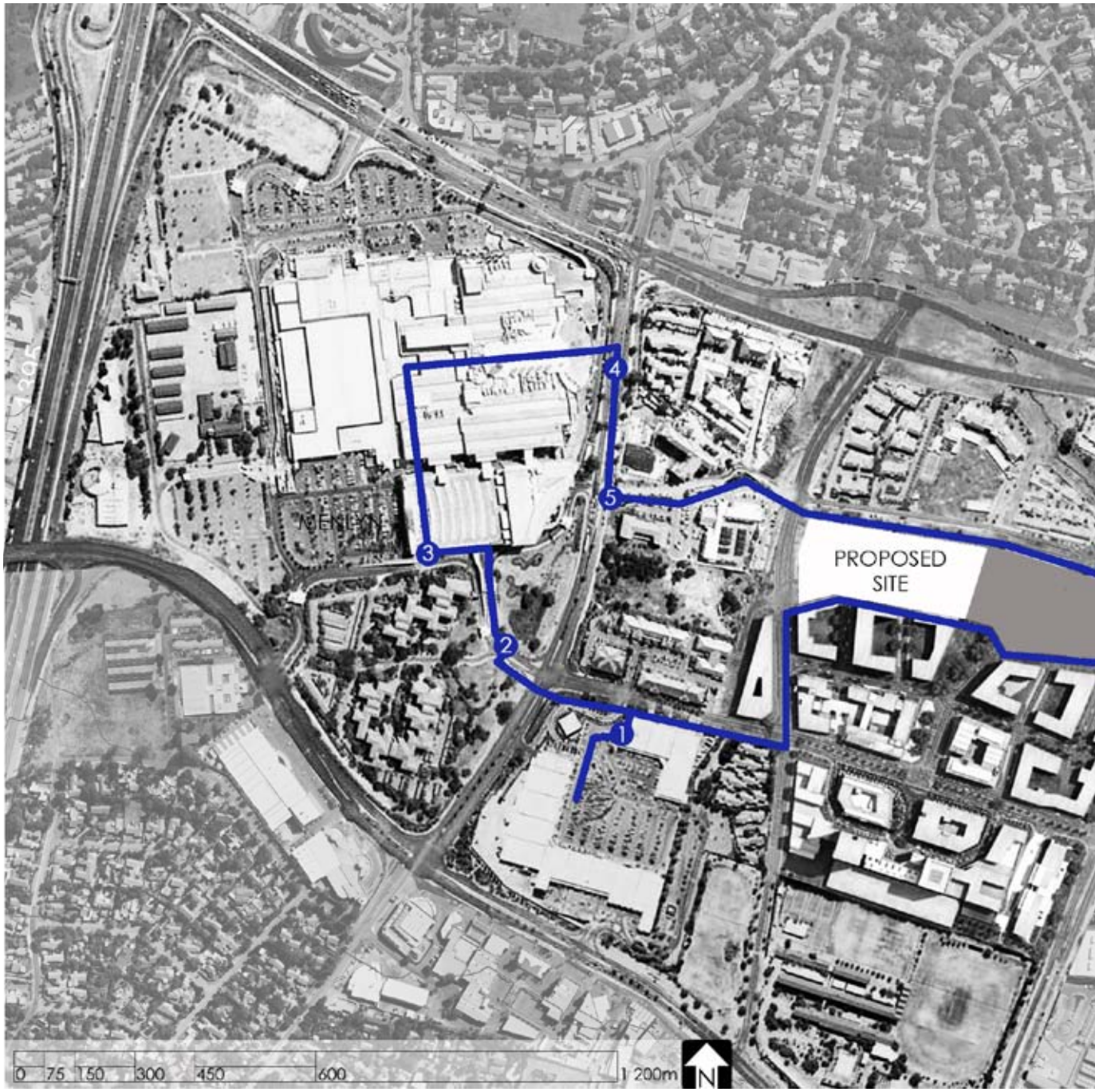
Informal interviews with pedestrians in the area and personal observations assisted the author to compile the following list of factors influencing the pedestrian experience of the area:

- Shopping centres are mostly introverted, surrounded by parking lots and garages through which pedestrians are forced to enter (illus. 2.6-7).
- Pedestrian crossings are spaced at intervals of approximately 400-800m.
- Pedestrians are rendered vulnerable by the placement of sidewalks directly next to three- and four lane roads (illus. 2.6,8&9).
- Taxis often make use of sidewalks to stop, forcing pedestrians onto the road.
- Bus shelters are located directly on sidewalks, leaving limited room (±300mm) for pedestrians, forcing them onto the road (illus. 2.8).
- Size of city blocks within the Menlyn precinct are large in comparison with other cities' blocks. This observation is confirmed by the data in table 2.1.

ILLUS. 2.7: Pedestrian path through parking garage.

ILLUS. 2.8: Bus shelter located on sidewalk.

ILLUS. 2.9: Three-lane road with jaywalker.



ILLUS. 2.10: Aerial map of route.

Hierarchy of Roads

1. N1 Highway

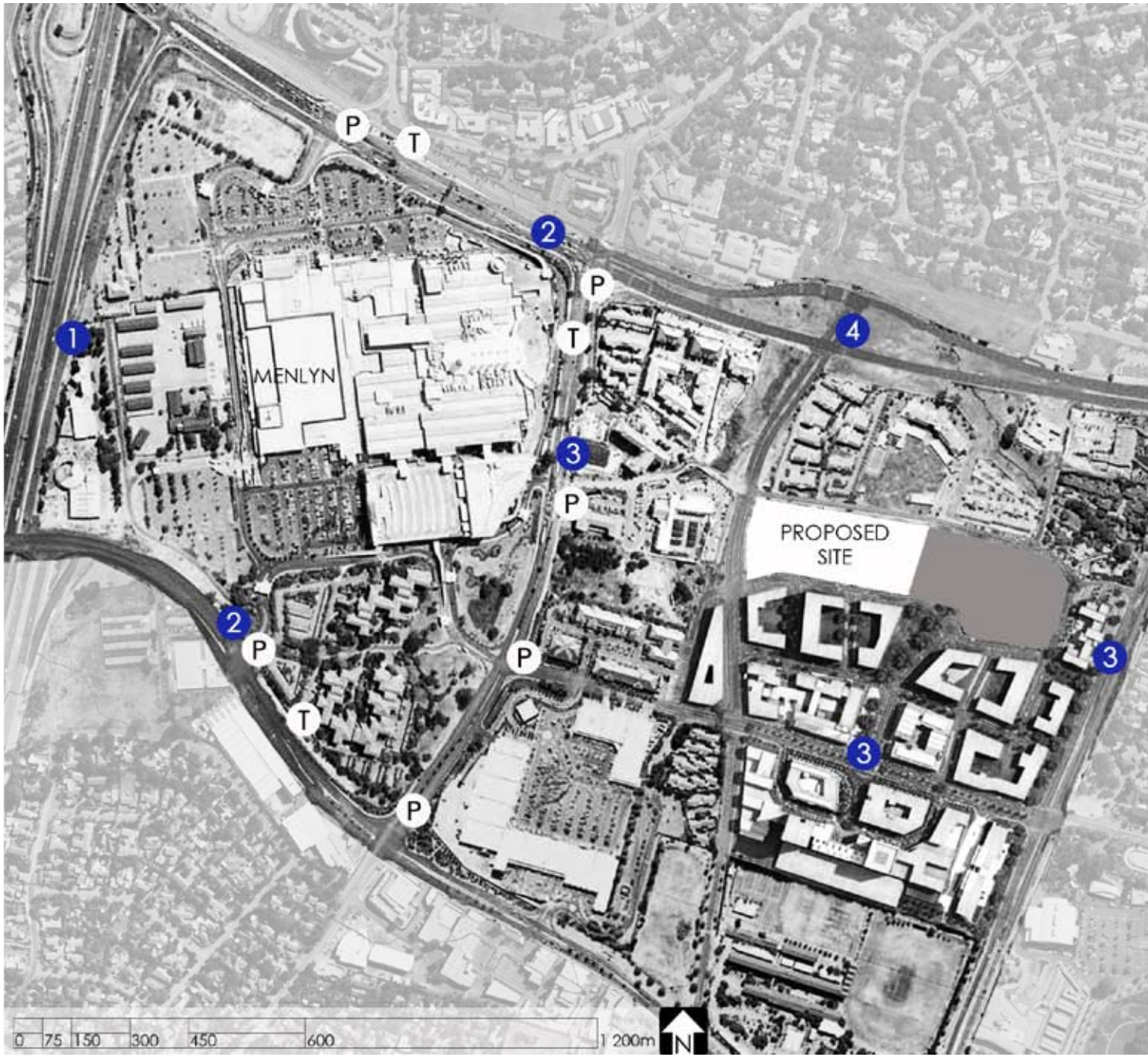
2. Arterials: North - Atterbury Road
   South - Garsfontein

3. Secondary Arterials:
   East - Genl. Louis Botha Drive
   South - Aramist Road
   West - Lois Avenue

4. Future upgrade - Dallas and Atterbury Roads

P Formal pedestrian crossing

T Informal taxi stop



ILLUS. 2.11: Hierarchal layout of roads in Menlyn; Existing informal taxi ranks and formal pedestrian crossings.

Type of Road	Distance between (km)	Speed (km/h)	Private Access	On Street Parking
Highway	8 – 10	80-120	No	No
Major Arterials	2.5 – 3.0	100	Minimal	No
Minor Arterials	2.5 – 3.0	80 - 100	Minimal	No
Collector	1.0	60	Yes	Yes
Local Streets	0.3 - 0.5	40 - 60	Yes	Yes

TABLE 2.2: Hierarchy of roads (Personal communication with Pretorius, 2011.)

MOTOR VEHICLE

During recent years, the Menlyn precinct has undergone rapid growth and traffic problems have escalated accordingly. (City Planning Committee, 2002: [9]). Upgrades of major arterial roads (table 2.2) such as Atterbury and Garsfontein Roads together with the N1 highway have improved existing traffic problems. The future upgrade of Dallas Road, a minor arterial, could improve the accessibility of the Menlyn precinct (Illus. 2.9) (City Planning Committee, 2002: [18]).

ILLUS. 2.12: History of mini-bus taxi industry. (Left)

ILLUS. 2.13: Lois Avenue taxi stop. (Below)

ILLUS. 2.14: Atterbury Road taxi stop.

TAXI

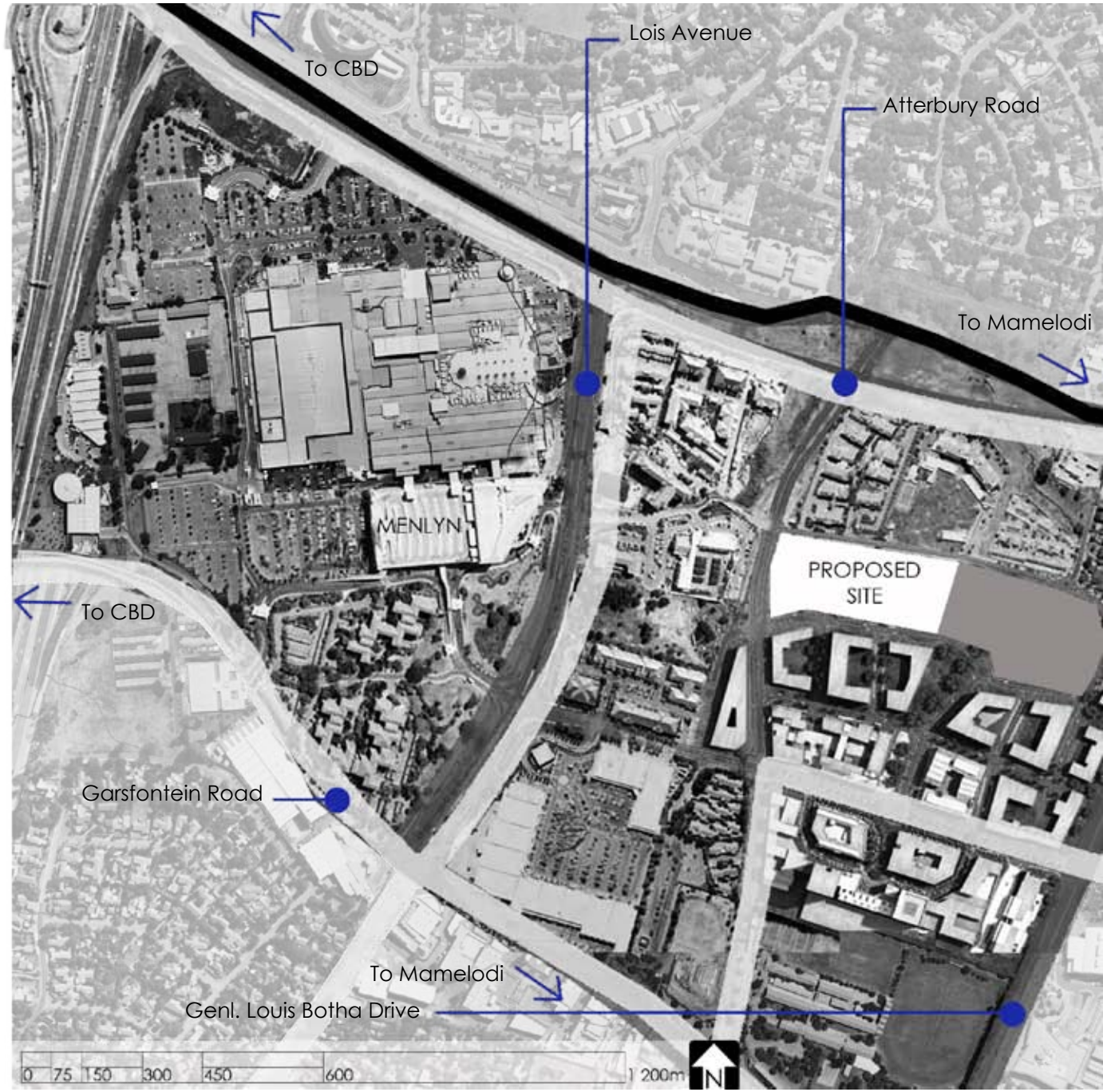
The mini-bus taxi industry originated during the 1970's (illus. 2.12) to meet the transportation demands of people living on the city outskirts (International Labour Organisation, 2003: 8). Currently, 66% of all public transport users make use of mini-bus taxis (International Labour Organisation, 2003: 9). The minibus (15- and 18 seater) taxi is the most common form of public transport in South Africa (International Labour Organisation, 2003: 4).

In the Menlyn precinct, there are currently three informal taxi ranks (or stops) operating between Menlyn, the Pretoria CBD and Mamelodi. These taxi stops cause disruptions to normal traffic. Taxis often block buses from accessing existing bus stops and sidewalks are used as taxi parking bays. Furthermore, taxi and bus stops are located far from designated pedestrian crossings - resulting in jaywalking (page 14).

BRT

Tshwane bus

Putco

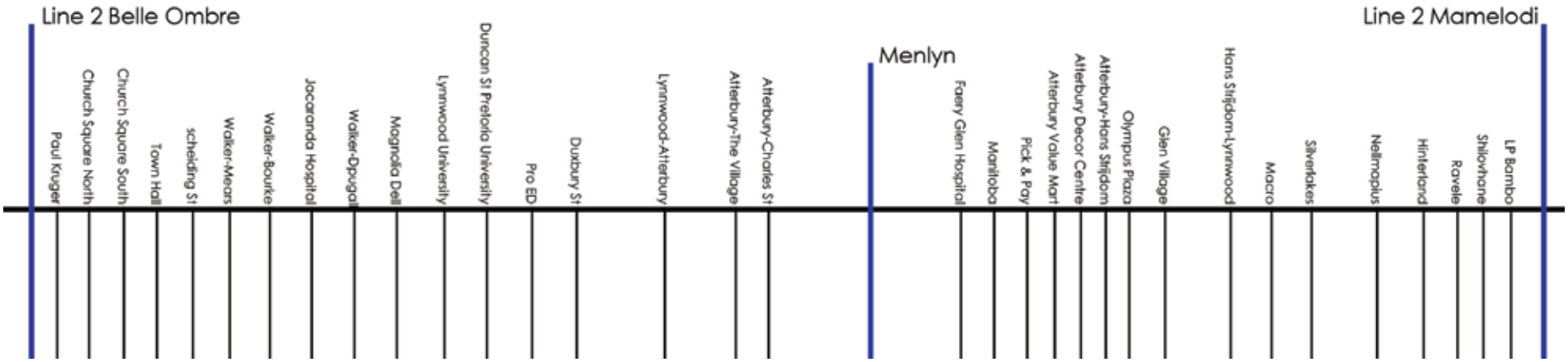


ILLUS. 2.15: Plan of existing bus routes at Menlyn precinct.

BUS

The Menlyn node is intersected by four important roads connecting it to the surrounding suburbs and to urban destinations further afield (illus. 2.15). Many Tshwane municipal bus routes are located in the Menlyn node and connect the surrounding suburbs with the Pretoria CBD. Putco bus routes also traverse the area and connect the Menlyn node to Mpumalanga, Mamelodi and the Pretoria CBD.

Pretorius (2000: [2]) states that the following characteristic shapes the nature of cities: people "do not like to travel more than half an hour to major urban destinations". The National Household Transport Survey (2007: 30) however indicates that the majority of Tshwane's residents take longer than 30 minutes to travel to work (Table 2.3).



ILLUS. 2.16: BRT Route Line 2.

TABLE 2.3: Travel times to work (National Household Survey, 2007: 30).

	<16 mins	16-30 mins	31-60 mins	61-90 mins	91-120 mins	>120 mins
City of Tshwane	10.5%	25.8%	37.9%	14.4%	7.0%	4.5%

The Bus Rapid Transit (BRT) system is planned to shorten this time, by introducing busses that will operate in dedicated bus lanes and minimise time spent in traffic. One of the planned BRT bus routes will travel through the Menlyn area and would encourage the use of public transport as well as the development of a transport corridor between Menlyn and the CBD (Engineering News, 2007; Advanced Logistics, 2008) (illus. 2.16).

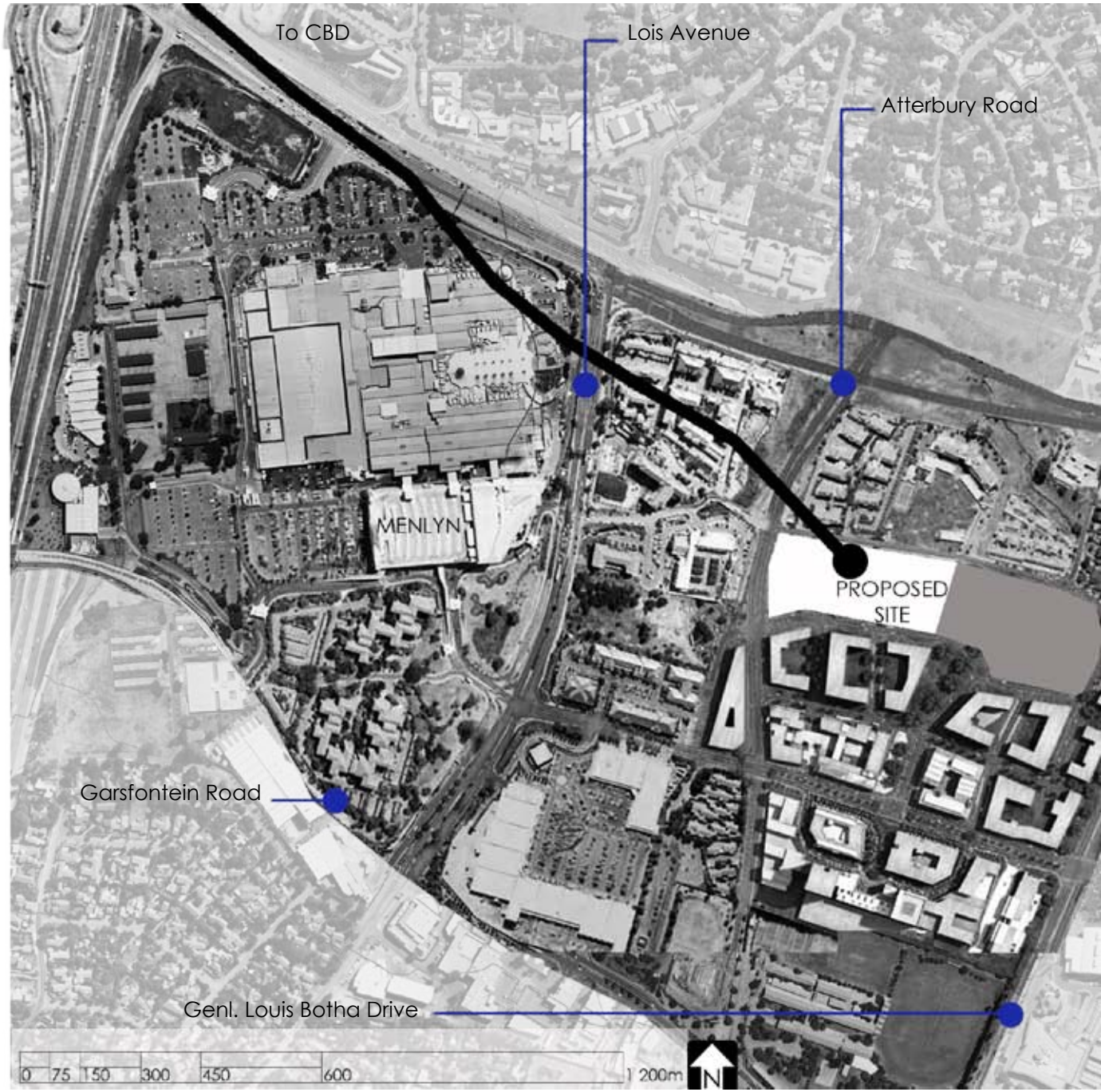
GAUTRAIN

The existing Gautrain Rapid Rail network comprises of two links. The first link is between Pretoria and Johannesburg and the second link is between OR Tambo International Airport and Sandton. The Gautrain forms part of one of eleven Blue IQ projects of the Gauteng Provincial Government. These projects aim to enhance economic growth, create job opportunities and to integrate the Gauteng transportation network (Gautrain, 2011b).

Presently, the last stop of the Gautrain, between Johannesburg and Pretoria, is Hatfield station. The route was designed for possible future extension from Hatfield to Menlyn. However, the precise location of the Menlyn Gautrain Station has not yet been determined. What is known about the future station is that it would be situated underground and within the proposed framework area.

The establishment of the Menlyn Gautrain station should enable a stronger connection with Pretoria CBD and Gauteng. This connection could serve the Menlyn node of Tshwane and possibly stimulate economic growth locally and within other connected areas. The Gautrain aims to create and sustain a new culture of public transport usage (Gautrain, 2011b).

Gautrain



ILLUS. 2.17: Plan of underground Gautrain route at Menlyn precinct.

2.2 MOTIVATION

"Major transportation and land use problems associated with the [Menlyn] node are presently experienced" (City Planning Committee, 2002: [1]). Although most transportation modes are present in the area, a lack of public transportation and pedestrian accessibility is still experienced (City Planning Committee, 2002: [3]).

The integrated improvement and cohesion of the various transport modes in the Menlyn area could benefit the greater Tshwane. In the next section, Transit Oriented Development as a means to address transport integration within an urban framework, is investigated.

2.2.1 TRANSIT ORIENTED DEVELOPMENT

A transit oriented development (TOD) refers to mixed-use, high density development located walking distance (400m or 5minutes) of a transport node. TOD assists with the access to transport facilities and increases the use of public transportation systems (Goodwill, 2002: 7). TOD could be used as a tool for transport integration. It focuses and attempts to amalgamate and establish proper communication between different modes of transport.

Newman (1996: 5), and Goodwill (2002: 9), claim that TOD makes economic sense, citing amongst others, the following reasons:

- Investment in public transportation infrastructure has double the economic benefit of investment in highways
- Transportation infrastructure can make it possible for a city to increase its density in areas near transportation nodes where most services are located, thereby creating more efficient city nodes as well as minimising urban sprawl.

2.2.2 DESIGN INTENT

An intermodal transport exchange could fuse the fracture between the different areas, transport modes and people of Menlyn. Furthermore, it could be argued that a Platform Building for the Gautrain stop at the Menlyn Intermodal Transport Exchange should improve the connection and accessibility experienced between Menlyn, Tshwane and Gauteng as a whole.

2.2.3 AIMS AND OBJECTIVES OF THE REMAINDER OF THE STUDY

- Use and apply data and knowledge obtained during the period of investigation to design a Gautrain Platform Building at Menlyn.
- Determine the needs of the users of a Gautrain Platform Building at Menlyn.
- In response, design a Gautrain Platform Building that will meet the needs of its users.
- Create a facility that is accessible, safe and legible to frequent users as well as visitors.

CHAPTER 3
THEORETICAL ARGUMENT

In this chapter, the theoretical argument is developed. Transportation systems are abstracted and analysed alongside mathematical concepts and principles. These principles will be extended and used as design tools.

3.1 COMPLEX SYSTEMS

Complex systems contain such an abundance of activity that the human brain is unable to fathom all the different possible outcomes. (Uitenbogaard, 2011). These systems involve many components that interact with one another and the collective behaviour cannot be determined from analysing a single component (Rocha, 2003).

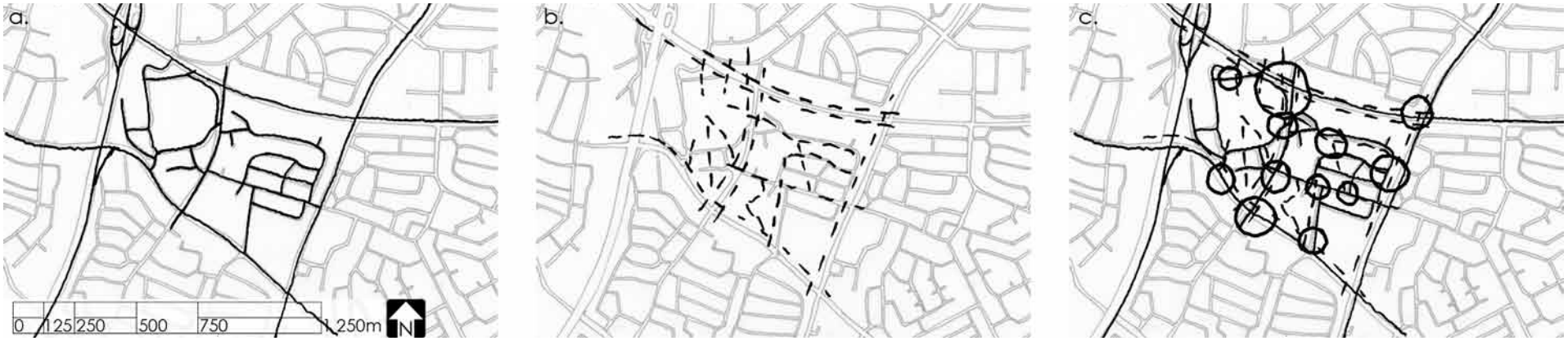
The transport system present in the Menlyn precinct is an example of a complex system (illus. 3.1). The different modes could be grouped into three categories:

- random - routes followed are undetermined
- probabilistic - routes followed are undetermined, but take place within a structured framework
- deterministic - routes are determined

The behaviour of the combination of these three groups together with their users cannot be anticipated and therefore forms a complex system which can be described as chaotic (Frazier & Kockelman, 2004: 1).

Chaos takes place when systems are sensitive to their initial conditions and when the outcome of these systems is indeterminate.

ILLUS. 3.1: Current Menlyn precinct transport system as complex system. (Below)



ILLUS. 3.2: Current Menlyn precinct transport system as chaotic system. a: Vehicular movement. b: pedestrian movement. c: Attractors/points of connection.

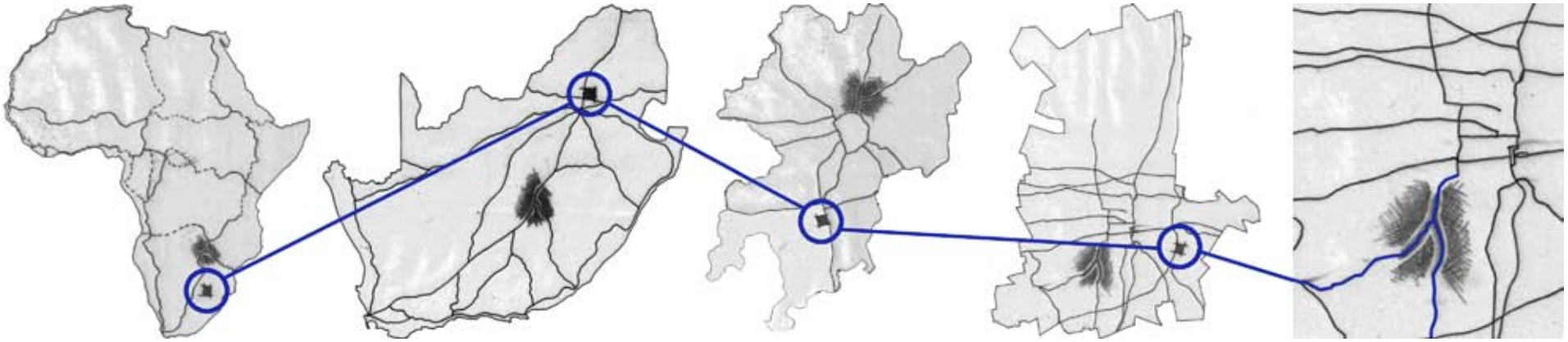
3.2 CHAOS THEORY

Chaos theory originated in the 1960's and this field of mathematics studies complex systems (Uitenbogaard, 2011). Chaos theory is used to analyse and understand complex systems and seeks to identify the underlying order within seemingly random systems (Rae, 2008). An advantage of chaos theory is that it could be used to reveal system information and relationships within a system without having to discover new laws or equations (Frazier & Kockelman, 2004: 1). Within a complex system, the information that is revealed usually consists of some sort of order. This order is termed the 'attractor' and within chaotic systems often presents itself as a self-repeating or self-similar pattern or fractal (ibid.: 2).

Frazier & Kockelman (2004: 1) state that chaos theory may be useful in gaining a deeper understanding of transportation systems. Disassembled into single paths and transport modes, it is easy to understand transport networks, but the layering and interaction of various networks easily becomes very complex.

Given that "pathwise connectivity is most economical on a plane surface" (Salingaros, 2003: 12), different transportation networks are in competition with each other; sharing, meeting and crossing each other's paths. The competition formed by the interlacing of these networks results in chaos and adds dynamics to the system that cannot be understood by investigating only the system parts.

The aim of any transportation system is to connect people and places with one another. The attractor or underlying order of transport networks could be interpreted as 'connection' (illus. 3.2).



ILLUS. 3.3: Self-similarity of road connections across different scales. Important road networks of Africa, South Africa, Gauteng and Tshwane respectively.

3.3 FRACTALS

As mathematical shapes, fractals present the fascinating property of being "both very simple and infinitely complex at the same time" (The Fractory, S.a). Bovill (1996: 3) defines fractal geometry as "the study of mathematical shapes that display a cascade of never-ending, self-similar, meandering detail as one observes them more closely". Fractals thus have the same pattern or properties at different scales and can even be said to render an object scale-less.

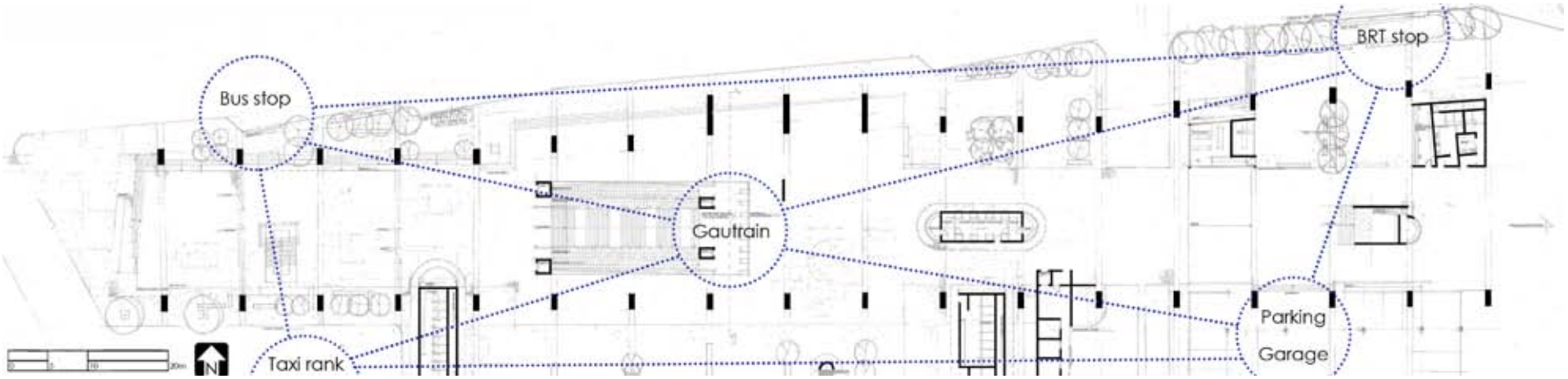
Bovill (1996: 3) states that fractals are integrated into our being to such an extent that our "senses, having evolved in nature's similar cascade, appreciate self-similarity in designed objects". Fractals are present in many architectural works, but are only deemed 'fractal' if built after 1970 when the concept was first investigated by mathematicians (Joye, 2007: 311).

With regards to design, fractals are interpreted as two-dimensional design inspirations. A pattern is chosen and repeated across the entire spectrum of the design. This interpretation seemingly lacks depth and the question as to how fractals can contribute to meaningful architecture arises. The mathematician who first identified the concept of fractals, Mandelbrot (1924-2010) in Bovill (1996: 115), hints at a possible answer to this question by stating that fractals in architecture refers to a progression of interest from the very large to the very small scale, a mix of order and surprise.

The aim of a Gautrain Platform Building at Menlyn is to connect people and places with one another. The idea of connection, if applied to different scales within the design, would result in a fractal concept of connection (illus. 3.2-3).

ILLUS. 3.4: Collage of images indicating self-similarities in Menlyn precinct. (Opposite)

ILLUS. 3.5: Palais de Justice, Nantes (2000), by Jean Nouvel. Progression of interest at different scales.



3.4 SMALL-WORLD NETWORKS

Salingaros (2003: [1]) states that "cities have intrinsically fractal properties". He argues that the automobile has contributed to the creation of anti-fractal urban typologies (car cities) in the 20th century, which destroyed the fractal nature existing in cities.

Salingaros (2003, [2]) is of the opinion that pre-modernist cities can be described as fractal or pedestrian cities, "because they work on all scales". Traditional urban form was an effect of the pedestrian transportation web, with the addition of incremental additions, for example, a rail or tram network. Modifications to the transportation systems lead to transformations of the city structure. Technical aspects and flows of vehicles are used as the central concept of design of modern transportation infrastructure (Van der Spek, 2006: [1]).

To reintroduce the pedestrian city, "one has to rebuild a new pedestrian network into the car city" (Salingaros, 2003: [6]). Dupuy in Salingaros (2003: [7]) states that a city's life is determined by its connectivity. One could argue that the motor vehicle increases the connectivity of a city, ironically the motor vehicle actually isolates a person from his/her surroundings, and 50% of the urban surface is sacrificed for parking (Salingaros, 2003: [9]).

Small-world networks are networks "where nodes are connected by both long and short links" (Salingaros, 2003: [15]). Through the application of small-world networks to the urban fabric and especially the urban transportation network, multiple-connectivity can be achieved between different nodes as well as different transportation modes and scales (illus. 3.5).

With the assurance of an urban framework and a design resolution that addresses the scale of all these modes, the design should become fractal.

3.5 CONCLUSION

Chaos theory, fractal geometry and small-world networks are seemingly abstract concepts with regards to architecture. Graafland (2008: 6) states that the "problem nestles in the 'translation' of these theories into meaningful practices". The Platform Building at Menlyn is to make use of these theoretical principles to design a platform for the Gautrain users and users of other transport modes. Users

ILLUS. 3.6: Small-world network principles applied to design proposal. (Opposite)
ILLUS. 3.7: Principle of small-world networks applied to Tshwane. (Right)

would be able to transition and connect with one another as follows:

- Small-world network principles should be applied to both the urban framework and design proposal.
- A sense of continuity in the perception of users should be established as a result of self-similarity on various scales of the design.
- Self-similarity should be used as a tool whereby architectural legibility may be enhanced.