Injecting a rapid rail link into a metropolis

INTRODUCTION
The Gautrain Project being developed in Gauteng is currently the largest construction project on the African continent. At an estimated cost of some R25 billion, it surpasses any previous single project in South Africa, and will result in a vital rapid rail link between Johannesburg, Pretoria and Johannesburg’s OR Tambo International Airport. The total route length of 80 km will comprise some 15 km of tunnels in Johannesburg, about 10.5 km of viaducts along various sections of the route, and the balance will be on surface or in shallow open cut.

The Gautrain is being developed by the Gauteng Provincial Government through a Public Private Partnership concession contract with an international consortium of major players in the construction, public transport vehicle manufacturing and operations fields. While construction is taking place over a period of some four years to 2011, the Concessionaire will operate the full system for a further 15 years. With ten stations being built along the route, profound land use challenges and opportunities arise. Superimposing a rapid rail artery of this magnitude onto the urban landscape of three metropolitan areas is bound to have considerable environmental and land use impacts. This article demonstrates how these impacts are being addressed and how the natural and built environment is being considered and perhaps even enhanced, rather than being adversely affected.

TRAVEL DEMAND AND NEED FOR A RAPID RAIL SYSTEM
Vehicle ownership in South Africa has increased sharply in the past two decades, in line with the accelerated socio-economic development of many of its citizens. This places heavy demands on the transportation systems,
and in particular on the road systems, in the light of lower than ideal levels of rail freight and rail patronage. While Wegener and Fürst [2] argue that trip length should be negatively correlated with city size, metropolitan freeways in Gauteng have become heavily congested, filled with long trips and resultant travel times that are beyond what should be tolerable in South Africa.

With the hosting of the 2010 FIFA World Cup by South Africa, major infrastructure programmes were executed, including the construction of various new and enlarged sport stadiums, freeway and other road improvement programmes, and bus rapid transit (BRT) systems in different metropolitan areas. In Gauteng, the National Roads Agency is currently improving about 145 route kilometres of freeway. However, a major shortcoming in the bigger metropolitan transport framework has been the lack of a high capacity public transport facility to cater for travel demand between important activity nodes in Gauteng. The Gautrain Rapid Rail Link is expected to address this shortcoming.

**THE PROJECT IN BRIEF**

**The contract**

The Gautrain is being constructed as a Public Private Partnership development in two major phases in the metropolitan areas of Johannesburg, Ekurhuleni and Tshwane (Pretoria). After a very extensive planning and bidding process between 2000 and 2006, the project was awarded to an international consortium consisting mainly of Bombardier (Canadian), Bouygues Travaux Publics (French), Murray & Roberts (South African), Strategic Partners Group (South African) and RATP Développement (French). The private partner consortium, called Bombela Concession Company, has entered into a 19.5 year concession agreement with

1. The Gautrain route
2. Internal finishes within the station concourse shell at Sandton Station
3. Completed finishes on concourse level at Sandton Station
the Gauteng Provincial Government for
the design and construction (4.5 years)
and the operation and maintenance (15
years) of the system. A total of 24 train
sets, operating at 10 minute headways,
will be used in conjunction with some
125 buses in feeder/distribution ser-
vice around stations.

Construction cost, programme and current status
The total approved contract value is ap-
proximately R25 billion. The bulk of the
funding – around 88 percent – is from
Government, with the balance being pri-
vate sector debt, while the Concessionaire
will carry operating costs.

The Concession Agreement was
signed in September 2006, with Phase 1
planned to be operational by mid 2010,
and final completion scheduled for 2011.
Phase 1 comprised the section between
Sandton Station and the OR Tambo
International Airport, including the
maintenance depot, while the balance of
the route south to Park Station and north
to Pretoria and Hatfield Stations form
Phase 2. Although operational readiness
of Phase 1 in time for the FIFA World Cup
had never been a contractual require-
ment, all parties appreciate the impor-
tance of having achieved this.

INTEGRATING GAUTRAIN
WITH ITS ENVIRONMENT

Development objectives
The Gautrain project is part of the stra-
tegic development goals of the Gauteng
Province. It also meets the needs and re-
quirements reflected in the National Land
Transportation Transition Act of 2000,
which requires Government to prioritise
and promote public transport and to im-
prove the image of public transport. Thus,
already in 2001, the following were some of
the objectives approved for Gautrain [4]:
- to stimulate economic growth, develop-
ment and job creation
- to reduce severe traffic congestion in
  the Tshwane – Johannesburg corridor
- to promote the use of public transport
to contribute significantly towards urban restructuring, shortening of travel distances and improving city sustainability

to stimulate the renovation and upliftment of the Johannesburg and Tshwane Central Business Districts

to link the main economic nodes in Gauteng

to comprise a significant part of a holistic transport plan and network for Gauteng.

The above presupposes a considerable degree of sustainable integration of Gautrain into Gauteng Province’s transport system, economic development activities and natural environment. This was also a key requirement for the approval of the project by Government and is in line with current global thinking concerning successful integration of land use and transportation (Hine [5]).

Densification of land uses near rapid transit routes and stations has for the past few decades been a prime objective of authorities on different continents. Stockholm was one of the first cities to link new town development with guided transit planning. Others, like Toronto, Hong Kong (with high government control over land), Lille Metropole, Edinburgh, Atlanta (MARTA), Auckland, and recently Shanghai, are some examples of application of the principles of so-called Transport Development Areas (TDAs).

South African metropolitan development has followed the North American pattern of ever increasing urban sprawl and great reliance on the motor vehicle. Any opportunity to turn this tide towards increased densities and transit usage is to be actively pursued.

**Land use and modal integration around stations**

In pursuance of integrated land use planning at stations, the Province embarked on an initiative with the local municipalities to develop functional area guidelines to supplement local spatial development frameworks in the vicinities of the respective Gautrain stations. The development of areas within a one kilometre radius of stations was considered, with a view to:

- creating or reinforcing densities
- promoting ridership (getting people to stations)
- establishing mixed land use around stations, thus with varying travel patterns throughout the day
- ensuring appropriate and high density land use
- establishing new urban form that embraces the Gautrain
- establishing integrated public transport nodes.

In most instances Urban Development Frameworks, taking full cognisance of the Gautrain stations and their impact on land use, have been completed and are being implemented.

The station precincts obviously present superb opportunities for commercial development and it is thus not surprising that land use applications for several million square metres of new development are being considered, representing potential capital investment in excess of the construction price of the entire Gautrain project in the next decade alone.

Physical integration with other modes of travel has received attention during the planning of the Gautrain stations. In addition to the integration afforded by the system’s own feeder/distribution bus service
Environmental integration

Legislative framework

Environmental concerns regarding physical development in South Africa are regulated, inter alia, by the National Environmental Management Act (Act 107 of 1998) and the Environment Conservation Act (Act 73 of 1989). The Gauteng Department of Agriculture and Rural Development (GDARD) acts as provincial implementers of these acts. GDARD issues Records of Decision (RoDs), approving or disallowing projects or aspects thereof, based on Environmental Impact Assessments (EIAs). The RoD on the proposed Gautrain Rapid Rail Link contained a series of conditions including the formulation and approval of an Environmental Management Plan (EMP) that will govern design, construction of, and ultimately operations and maintenance activities on the rail system.

Environmental impact in practice

Naturally, the most visible impact of such a mammoth project is likely to be the civil construction work. Building operations are bound to be disruptive at times, with very visible impacts on the environment, including large earth embankments or cuts, numerous large, very busy construction sites, and the like. Furthermore, noise pollution during construction has to be kept to within acceptable limits, particularly in or close to residential and business areas.

Several occasions arose during the planning and design of the system when very positive environmental impacts resulted. Examples are:

- Near Marlboro Station, where the line is on viaduct, increasing the viaduct spans obviated the need for deviation of a very large sewer main, which could have posed a major environmental risk.
- The route through Centurion was originally planned to be in a tunnel. Dolomites in the area prompted an alternative alignment on viaduct, which does have a visual impact, but was considered preferable to the risks associated with tunnelling through dolomites. Furthermore, a Water Management Plan regulates the handling of storm water from the system throughout the dolomite area, to reduce runoff into the dolomite substrata.
- North of Centurion, an at-grade U-shaped reinforced concrete structure is used across an area of varying geological nature to reduce the adverse impact the rail line could have had in an area of deep dolomites.
- In a part of the tunnel section where geotechnical investigations indicated extremely variable rock conditions, it was decided to employ a Tunnel Boring Machine (TBM) which was imported from Germany to drill and place the lining to some three kilometres of tunnel under Johannesburg.
- Naturally all of the cut and fill slopes in the formation are being landscaped and graded as soon as civil construction allows this, to limit the impact on the physical environment.
- Concerning noise and vibration, the specification for the system has very strict international compliance standards, and where these standards could not normally be attained at rail reserve edge, noise barriers and/or vibration dampening pads are used to mitigate any adverse effects.

A GLIMPSE INTO THE FUTURE

The Gautrain is the first of its kind, not only for South Africa, but for the entire African continent. More systems such as this one have to, and will, follow. Furthermore, the Gautrain system will have to expand in future, and provision is made in the planning and design of the system to extend the southern, northern and eastern ends, should future demand warrant this.

With tremendous densification around the Gautrain stations, urban form in the Gauteng province will be transformed. New population concentrations will create demand for goods and services on a scale that will see the birth of several new cities along the rapid rail route. Modderfontein and Midrand are relative new population concentrations, the formation are being landscaped and graded as soon as civil construction allows this, to limit the impact on the physical environment.

REFERENCES