

Dissertation by

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Towards the Revitalisation of the Kromboom Parkway through the Rehabilitation of the Kromboom River

Masters Landscape architecture

Department of Architecture and the built Environment

University Of Cape Town

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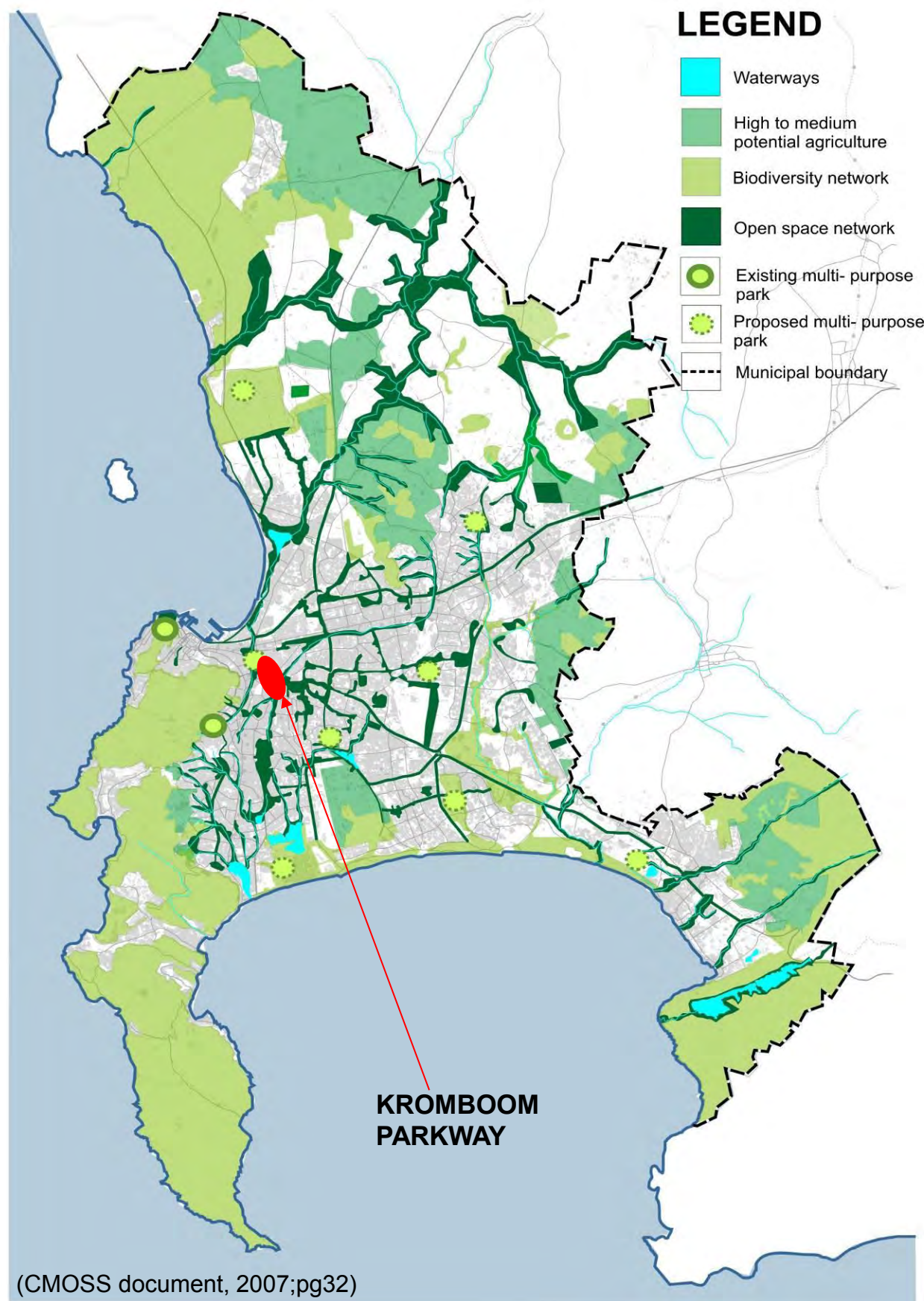
The system of public open space in South Africa is underperforming in relation to the natural assets this country possesses. After analysing the different aspects of the existing framework plans for the central metropolitan open space system, I was fascinated by the concept of linkage as vital to success. The Kromboom Parkway has always interested me because of its enormous potential, yet poor accessibility. By combining the study of rivers with the open space framework and the concept of green corridors the idea of a redesign of the Kromboom Parkway came about.

The analysis of the Public open space system at the larger scale puts the Kromboom Parkway into perspective, and it is a vital link. In fact without the concept of a green corridor from False Bay to Table Bay is without a foundation, because the link from north to south would be broken.

The Kromboom River is integral to the entire Kromboom Parkway pedestrian route. The Kromboom River itself is in need of erosion alleviation and some natural habitat construction to promote animal and plant life. In some cases the Kromboom River would be better off without the concrete canal.

Proposing a design for the Kromboom Parkway requires an understanding of pedestrians and their needs and dislikes, the disabled and how to make spaces accessible to them and children and how they interact with space.

Combine all these factors into a set of guidelines and the design starts to take shape.



(CMOSS document, 2007;pg32)

The Kromboom River forms part of the greater Black River catchment area, the open space framework plan, and the green corridor from Table Bay in the north to False Bay in the south.

Currently the open space framework is only partially operational, as many of the spaces are not open to the public, regardless of their being zoned public open space. Spaces which are open to the public are often in poor shape due to infrequent or non-existent maintenance, or are completely unsafe, due to the criminal activities occurring there, the lack of visibility onto the space and low numbers of pedestrian users.

The green corridor functions partly as a conservation area for animal and plant life, but the human applications of a movement route and recreation spaces are in severe disrepair. The public open spaces and conservation areas are all individually treated and used with little regard to connections between them, and frequently active blockages exist between them. It is not possible to follow the green corridor from False Bay to Table Bay on foot, as per the original intent. This is the result of poor to no maintenance, crime problems and a general ignorance of the greater connectivity plan by most inhabitants of the central metropolitan area.

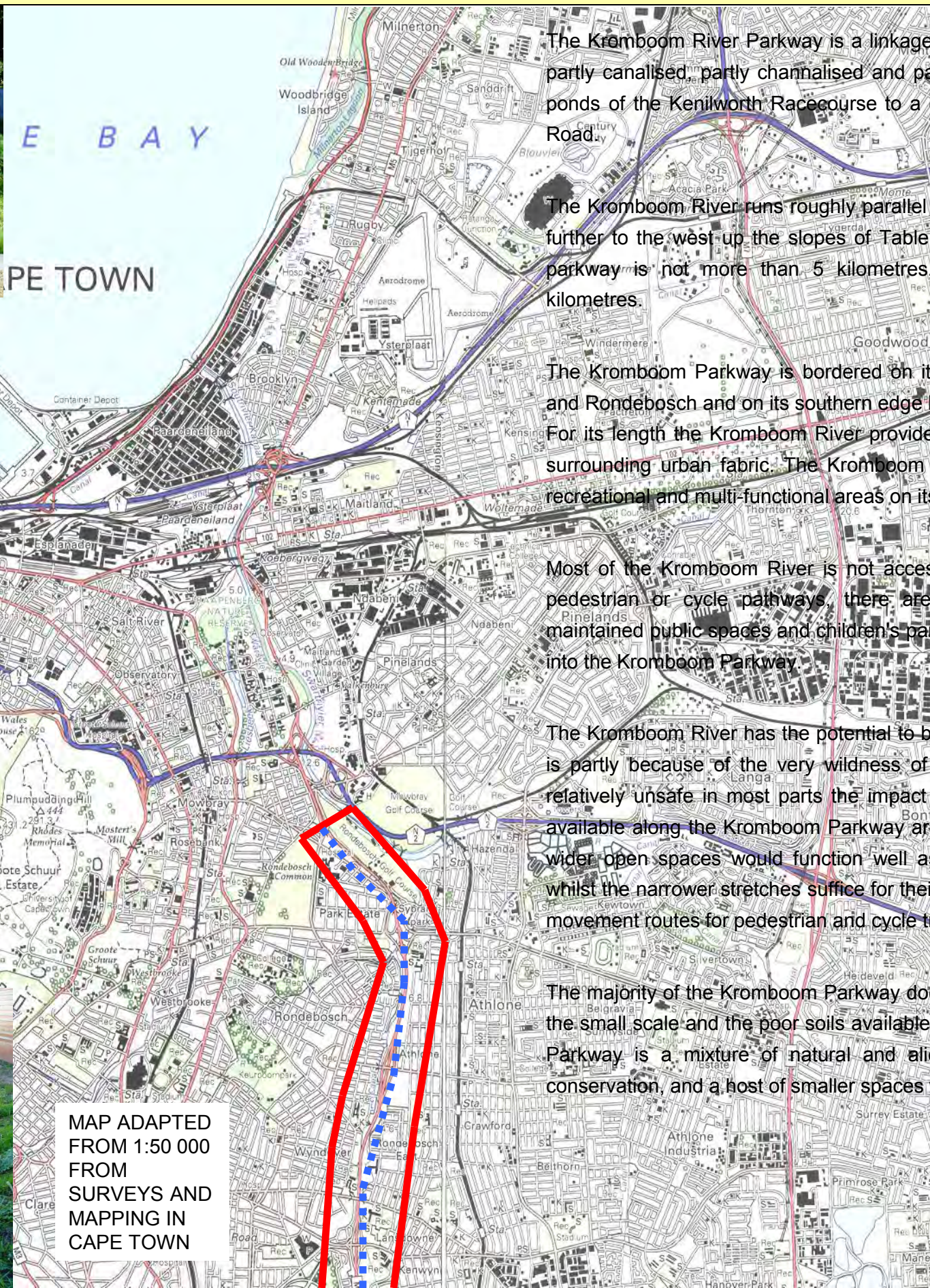
For the green corridor or the open space framework to function as intended, every space along the corridor would have to be made accessible, usable and safe – through the encouragement of heavier pedestrian and cycle traffic and subtle re-design to allow more visibility throughout.

Clearing all the blockages to connectivity, be they physical or otherwise, would open up the route and realise the connectivity, while also improving accessibility. Prospective users should be made aware of the existence of the route. A single language of design used along the entire route would help to breakdown any perceived separation between the spaces. Once again the emphasis should be on safety, accessibility and also ease of travel on foot from one destination to the next. Maintenance is important, spaces that become unkempt, filthy and unsafe due to lack of maintenance, do not and will not attract sufficient amounts of users to ensure the success of the open space system as a whole. Railway lines and roads are viewed as spaces for public transport, even though some may be excluded from using these transport methods due to lack of access or funds.

We must view the green corridor as the space for the most accessible form of public transport, pedestrian traffic.



FORM DETENTION PONDS IN THE KENILWORTH RACE COURSE TO THE CONFLUENCE OF THE BLACK RIVER AND KROMBOOM RIVER



E B A Y
PE TOWN

MAP ADAPTED FROM 1:50 000 FROM SURVEYS AND MAPPING IN CAPE TOWN

The Kromboom River Parkway is a linkage on the green open space system with a river partly canalised, partly channalised and partly in earth banks flowing from the detention ponds of the Kenilworth Racecourse to a confluence with the Black River at Klipfontein Road.

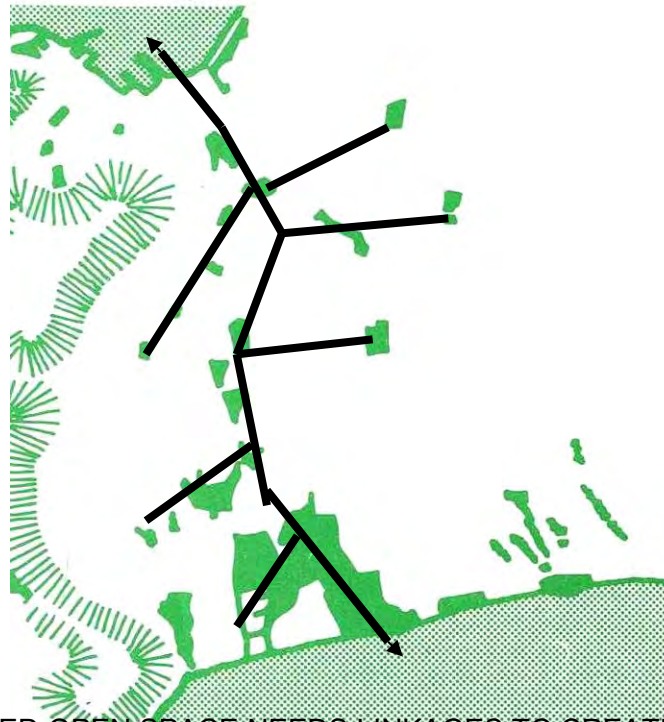
The Kromboom River runs roughly parallel to the course of the Liesbeek River which lies further to the west up the slopes of Table Mountain. The total length of the Kromboom parkway is not more than 5 kilometres, while the Kromboom River runs about 3 kilometres.

The Kromboom Parkway is bordered on its western edge by the suburbs of Kenilworth and Rondebosch and on its southern edge by Lansdowne, Rondebosch East and Athlone. For its length the Kromboom River provides a remarkable amount of edge space to the surrounding urban fabric. The Kromboom Rivers flows through commercial, residential, recreational and multi-functional areas on its route to meet the Black River.

Most of the Kromboom River is not accessible to the public. There are no designated pedestrian or cycle pathways, there are no river crossings. There are a few well maintained public spaces and children's parks along the route, but they do not link directly into the Kromboom Parkway.

The Kromboom River has the potential to be the most beautiful of the river corridors. This is partly because of the very wildness of its wilderness areas. However because it is relatively unsafe in most parts the impact of people has been slight. The open spaces available along the Kromboom Parkway are a variety of widths and lengths. Many of the wider open spaces would function well as developed parkland or conservation areas, whilst the narrower stretches suffice for their linkage potential and would offer comfortable movement routes for pedestrian and cycle traffic.

The majority of the Kromboom Parkway does not have a high agricultural potential due to the small scale and the poor soils available. The flora that can be found in the Kromboom Parkway is a mixture of natural and alien species, with two large areas worthy of conservation, and a host of smaller spaces with recreation potential.



FRAGMENTED OPEN SPACE NEEDS LINKAGES TO CREATE CONTINUITY.

ADAPTED FROM GREENING THE CITY, CITY ENGINEERS DEPARTMENT, 1982,pg27.



FRAGMENTATION CAN BE MADE A PERMANENT PROBLEM WITH THE ERECTION OF PHYSICAL BARRIERS.

The major problems relate to the failure of the open space framework and the green connectivity corridor to function in a coordinated and fully connected way. The minor problems derive directly or indirectly from these two major problems. The problems of safety, access, legibility, orientation and transparency all relate to the poor linkage of the different spaces to one another, resulting in little pedestrian traffic and poor knowledge of the Kromboom Parkway system of open spaces.

The problems of over-design and lack of design are related to the overall language of design for the Kromboom Parkway system, which lacks coordination and a common language. The Kromboom River is often over-designed in its concrete channel, whilst the public open space is lacking in development.

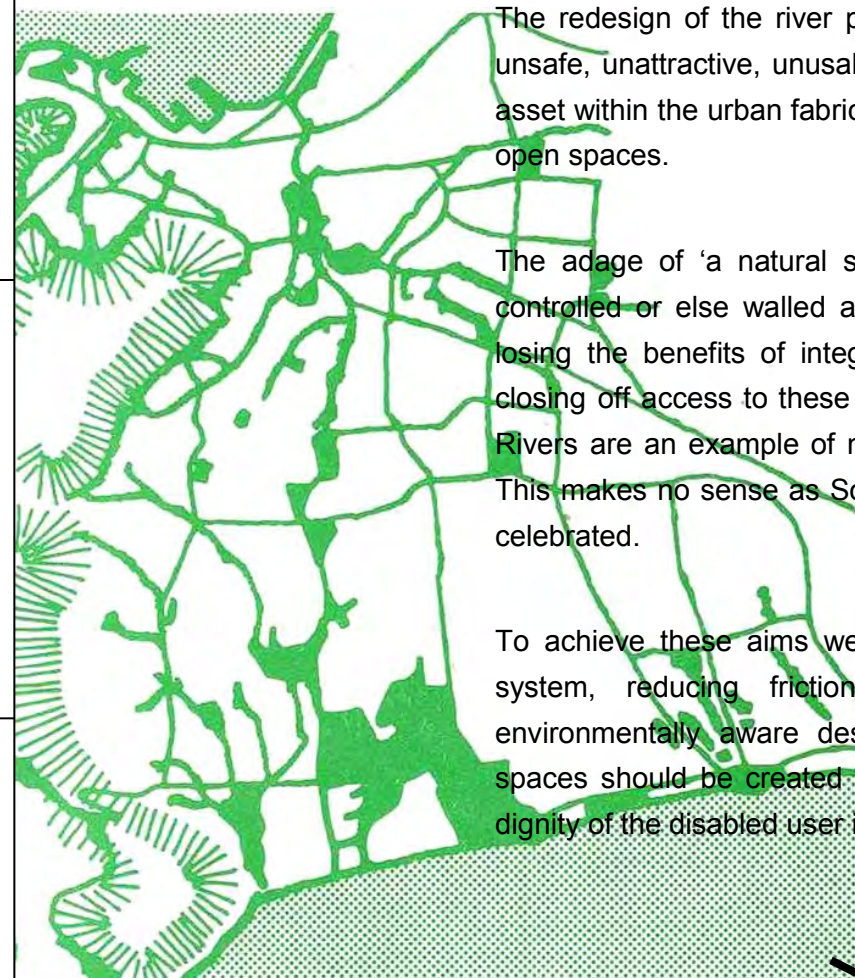
The danger to flora occurs mostly in the Rondebosch East Common and another large open space on the southern corner of the M5 highway and the Kromboom bridge. These open spaces have great potential for conservation, but the dangers of alien vegetation and human abuse need to be addressed. Flooding is not a great problem for the Kromboom River thus far. The Kromboom River manages the stormwater load without difficulty. The level of flood risk increasing the further downstream you go, flooding becomes a problem on the Black River. Erosion is a very localised problem on the Kromboom River. Only a short stretch of the Kromboom River is in earth banks, and that is where the erosion is currently occurring, with risk of undermining nearby trees. The usability of the Kromboom Parkway as a pedestrian route is not viable at present, with no existing pathways or other amenities provided as yet.

There are five factors to consider when dealing with any of the problems related to the Kromboom Parkway: The environmental aspect of how to rehabilitate the current canalised river to encourage flora and fauna, as well as the engineering aspect of how to ensure that flooding and erosion remain under control. The social aspects of safety also plays a role as does visibility and accessibility. Other social issues include the needs of the surrounding urban inhabitants and how the open space system addresses those; e.g. parks for children, walkways for cyclists and joggers, open spaces for sporting recreation, places of wilderness potential for the viewing of birds and other animals. The economic aspect dealing with the rezoning issues which may not be in favour of businesses and industries and Integrating the increased pedestrian traffic into the existing commercial framework. Finally the highway edge aspect with issues of noise and visual pollution as well as the danger fast moving traffic poses to children and animals.

1.4 Aims of this Dissertation



The aim of this dissertation is to propose a redesign of the Kromboom River. The redesign will include the creation of a coordinated and integrated system of spaces, with no blockages, clarifying the language of design using materials, street furniture and amenities. Using the Kromboom River as the unifying element which runs through the entire length of the Kromboom Parkway and creating paths along the Kromboom River to link all the open spaces on the Kromboom River and to propose the development of the existing open spaces to form a framework plan for the Kromboom Parkway which ties all the elements together.



The redesign of the river park attempts to show how an open space formerly deemed unsafe, unattractive, unusable and inaccessible can be altered to become a recreational asset within the urban fabric, as well as a gateway into the Kromboom Parkway system of open spaces.

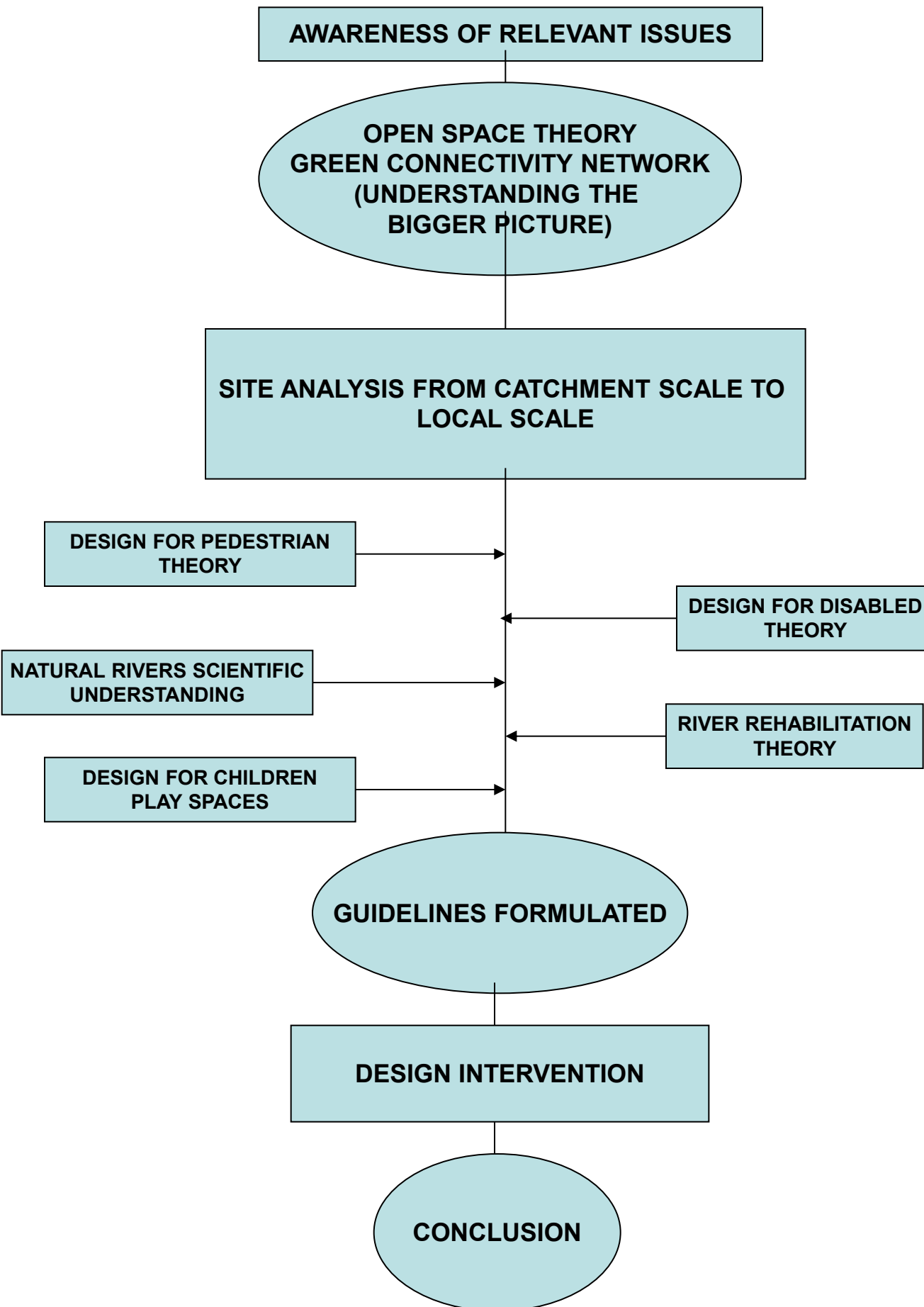
The adage of 'a natural space is a wilderness which needs to be either completely controlled or else walled away to keep us safe' can be overcome. South Africans are losing the benefits of integrating nature into their urban lives. Facing away from and closing off access to these spaces only turns them into the dangerous grounds we fear. Rivers are an example of natural assets which are turned away from and underutilised. This makes no sense as South Africa is essentially a dry country where water should be celebrated.

To achieve these aims we need a unified open space system, with a clarified green system, reducing friction with zoning and land-use. Examining and utilising environmentally aware design and engineering interventions. Visible and accessible spaces should be created to resolve issues of safety and the acknowledgement of the dignity of the disabled user is something that must be promoted.

PROBLEMS OF POLLUTION, EROSION, ILLEGAL DUMPING AND INACCESSIBLE OPEN SPACE CAN BE RESOLVED WITH A COORDINATED OPEN SPACE SYSTEM. THE RESULTS CAN BE SPACES FOR ALL USERS REGARDLESS OF PHYSICAL HANDICAPS.

ADAPTED FROM GREENING THE CITY, CITY ENGINEERS DEPARTMENT, 1982,pg27.





Firstly to analyse the CMOSS open space framework and the green corridor connectivity proposal, to place the Kromboom Parkway in the bigger picture, giving an understanding of the greater issues involved with open space planning.

The site analysis from the scale of 1:100 000 down to the scale of 1:1000, looking at soils, erosion, flora, fauna, stormwater, water quality, accessibility, movement, visibility, wind direction, steep slopes etc. to give an understanding of the physical environment and social environment.

Analyse the production of an existing framework plan of the Kromboom Parkway at a scale of 1:5000, using the site analysis as a source of information.

The study of natural rivers to create understanding of how the natural systems function and inter-relate to produce a healthy river system. The study of engineering impacts on rivers, both negative and positive, to understand what it is possible to achieve and what to avoid.

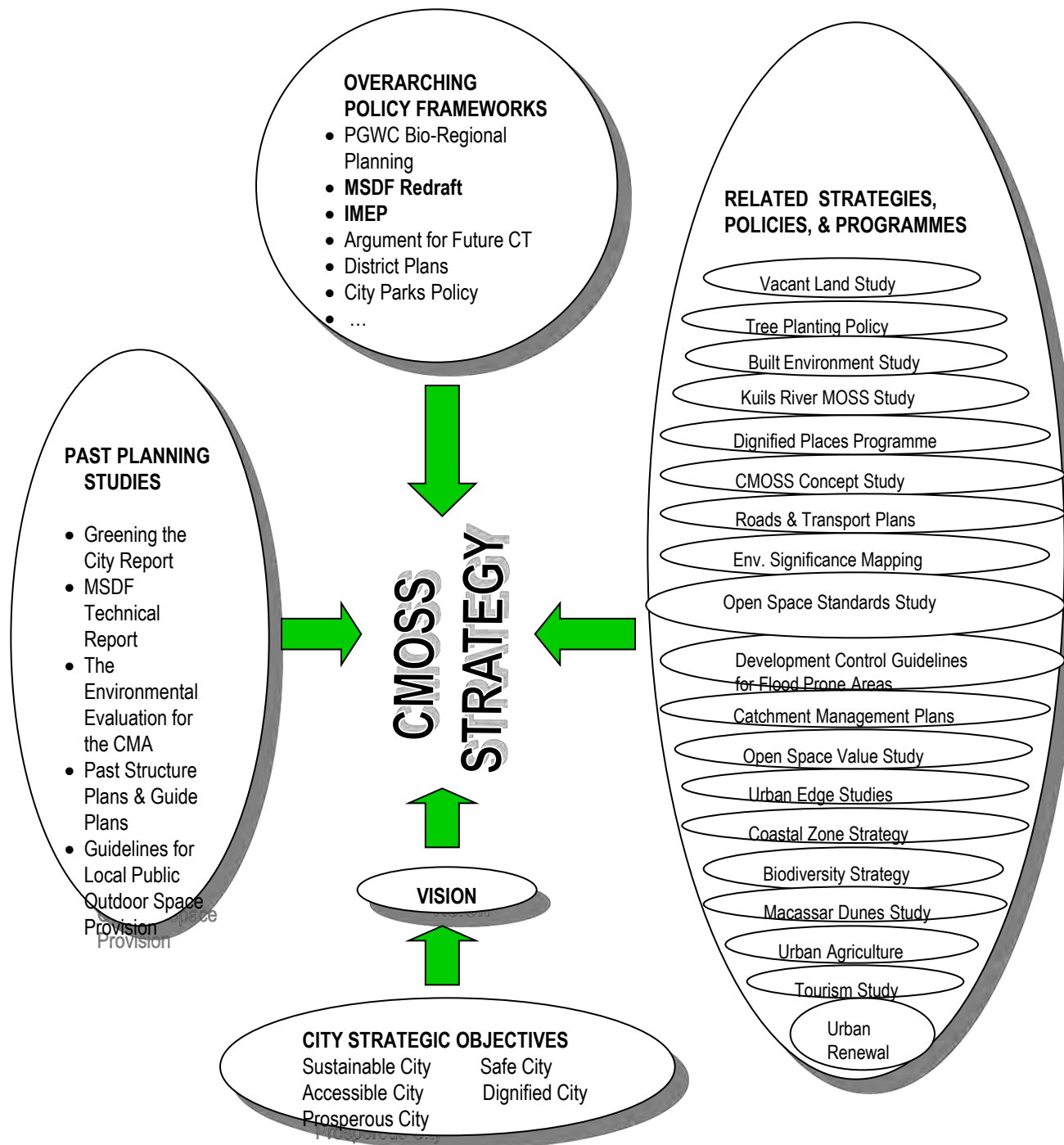
The study of theory on design for the pedestrian and the disabled user. Focusing on traffic reduction, qualitative design for public open spaces and accessible design for movement limited users.

The study of play spaces and in particular play space for children.

Synthesising the body of theoretical work into a set of guidelines.

Using the guidelines to inform a new framework plan for the Kromboom Parkway at a scale of 1:5000.

Producing plans, sections and details of specific interventions along the Kromboom Parkway, some of which are generic while others are site specific.



(CMOSS document, 2007;pg13)

2.1 Principles:

Avoid creating an uncoordinated open space policy, and ad hoc provision of open space (Ibid p2) which will lead to the side effect of useless fragments of land (SLOAP).

“Urban open space is vulnerable to fragmentation or replacement by other land uses, unless adequately protected. Once the space is lost it cannot recover its former use and value”. (CMOSS document, 2007;pgs 3,11,14)

2.2 Guidelines:

An **open space standard** is required and stipulates the minimum amount of urban land that should be allocated to open space expressed as a formulae. This formula should be variable so that it may take into account specific contexts, and should be re-evaluated from time to time to ensure it remains applicable.

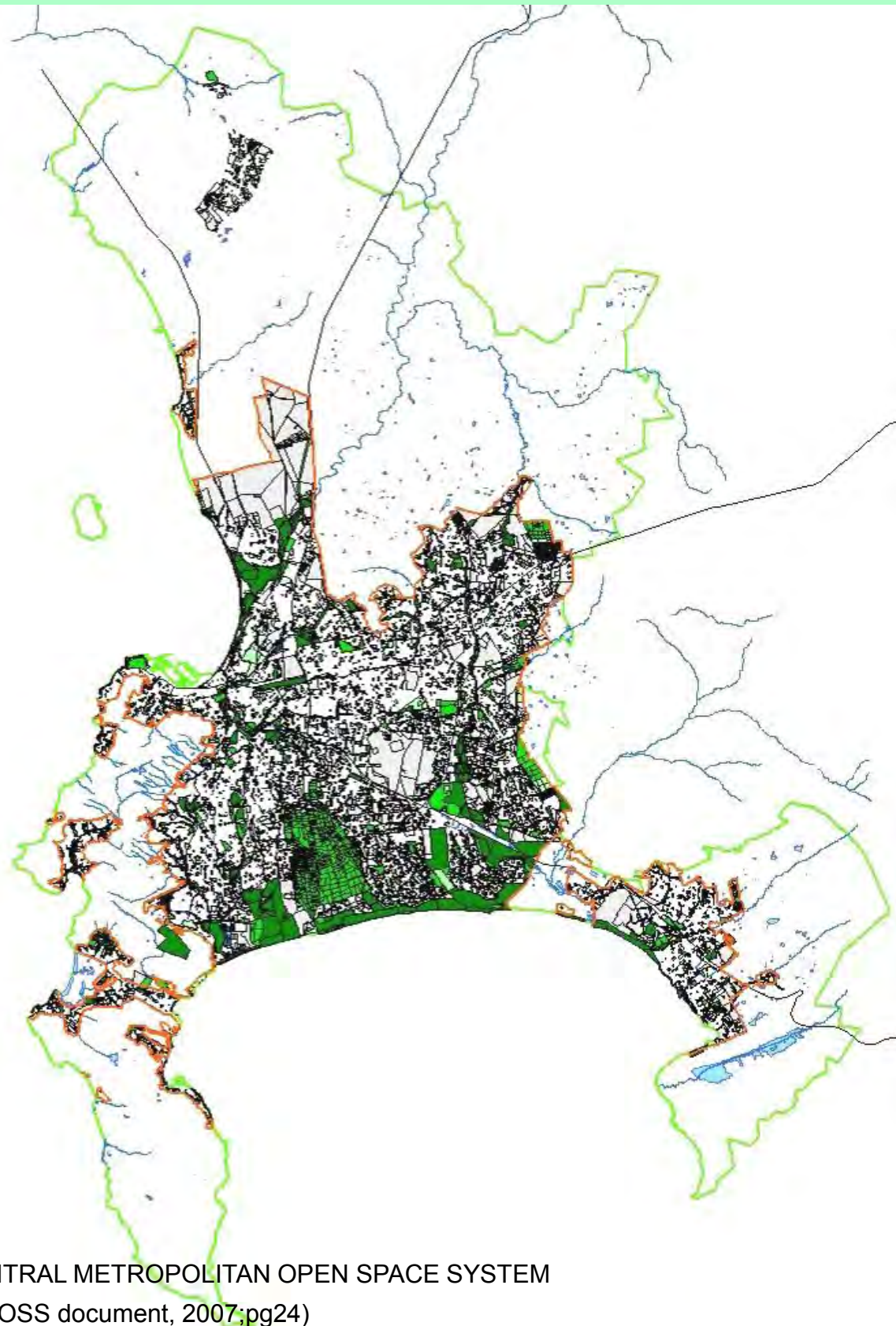
An urban resident should be able to enter a natural green space of at least 2ha within 0.5km of their home. Therefore provision should be made for a **statutory Local Nature Reserve** in every urban residential area with a minimum of 1 ha per thousand population. Furthermore there should be at least one 20 ha site within 2 km of all residents; at least one 100 ha site within 5km of all residents; and at least one 500ha site within 10 km of all residents.

2.2.1 Ecological guidelines:

Urban open space should serve to protect ecological systems through protective actions and regulations. These protective actions should be based on ecological research. Topographical features such as streams, wetlands, ridges and koppies etc. form part of the ecological systems that should be protected. Water systems, especially wetlands should be protected;

“..to facilitate the absorption and containment of storm water run-off, with controls on erosion, sedimentation, water pollution and over utilization of surface and subterranean water” (Ibid p4)

The **ecological system protective regulations** should stipulate the actions to be taken to ensure the systematic eradication of invader plants, the provision of interconnected corridor spaces to link open spaces in order to provide continuity of habitats, and protection of the inhabitants from *“man-caused natural disasters”* such as floods and erosion. (CMOSS document, 2007;pg11)



CENTRAL METROPOLITAN OPEN SPACE SYSTEM
(CMOSS document, 2007; pg24)

2.2.2 Recreational guidelines.

The provision of recreational facilities should be based on scientifically accountable research on the preferences of the specific community. The carrying capacity of the land should be taken into account during research, as well as the needs for both active and passive recreation in the community. Facilities for commuters in the form of pedestrian and cycle paths are worthy interventions, while safety and maximum accessibility remain the goals for users.

2.2.3 Aesthetic guidelines.

Visual amenity refers to aesthetic appeal of scenic landscapes, which should be retained and protected as much as possible. Open space should be treated as an integral part of the urban fabric.

2.2.4 Noise guidelines.

Open spaces are effective in helping to reduce noise pollution. This can be done through construction of berms or planting vegetation to screen sensitive receptors, such as residential areas or hospitals, from sources of noise such as traffic.

2.2.5 Educational guidelines.

The educational potential that can be offered by open spaces should be maximised by developing educational trails, and ecologically centred educational exhibitions, centres and activities.

2.2.6 Financial guidelines.

In examining the affordability and cost-effective management of open spaces design should pay attention various factors. Efficient organisation and control of the relevant involved departments will help to remain within financial perimeters. Exploring alternative methods of acquiring land, such as the acquisition of privately owned land as open space in exchange for certain privileges granted, or the re-zoning of privately owned land as "private open space" or preferably public open space. (CMOSS document, 2007; pg3). Public assistance should be sought in the maintenance of open spaces, and the maximisation of private sector involvement should be promoted to create a cost-effective management of open-spaces. Another method that can be used when examining the affordability of managing open-spaces is looking at preventative rather than rehabilitative measures that can be taken.

2.3 Open space planning in metropolitan Cape Town:

Open space plays a role in the health, well-being and cultural interests of a community. The various uses of open spaces include areas for recreation, both passive and active, aesthetic considerations, environmental education, religious and social uses as well as areas for pollution control and climatic influence. Open space can be used to conserve natural processes and ecosystems in the environment, for example wetlands, mountains, corridors for dispersal of animal species, habitats and useful natural processes which influence the air quality, air pollution and soil stabilisation. Movement corridors which could include rivers, roads and air fields, could also be integrated into open space. Open space planning can also provide separation between land uses and can also serve as a control for urban sprawl. (CMOSS document, 2007;pg14)

2.3.2 Discussion of Open Space Planning:

Rapid urbanisation can result in large previously open spaces, becoming occupied by unplanned informal settlements and ad hoc developments (CMOSS document, 2007;pg11).

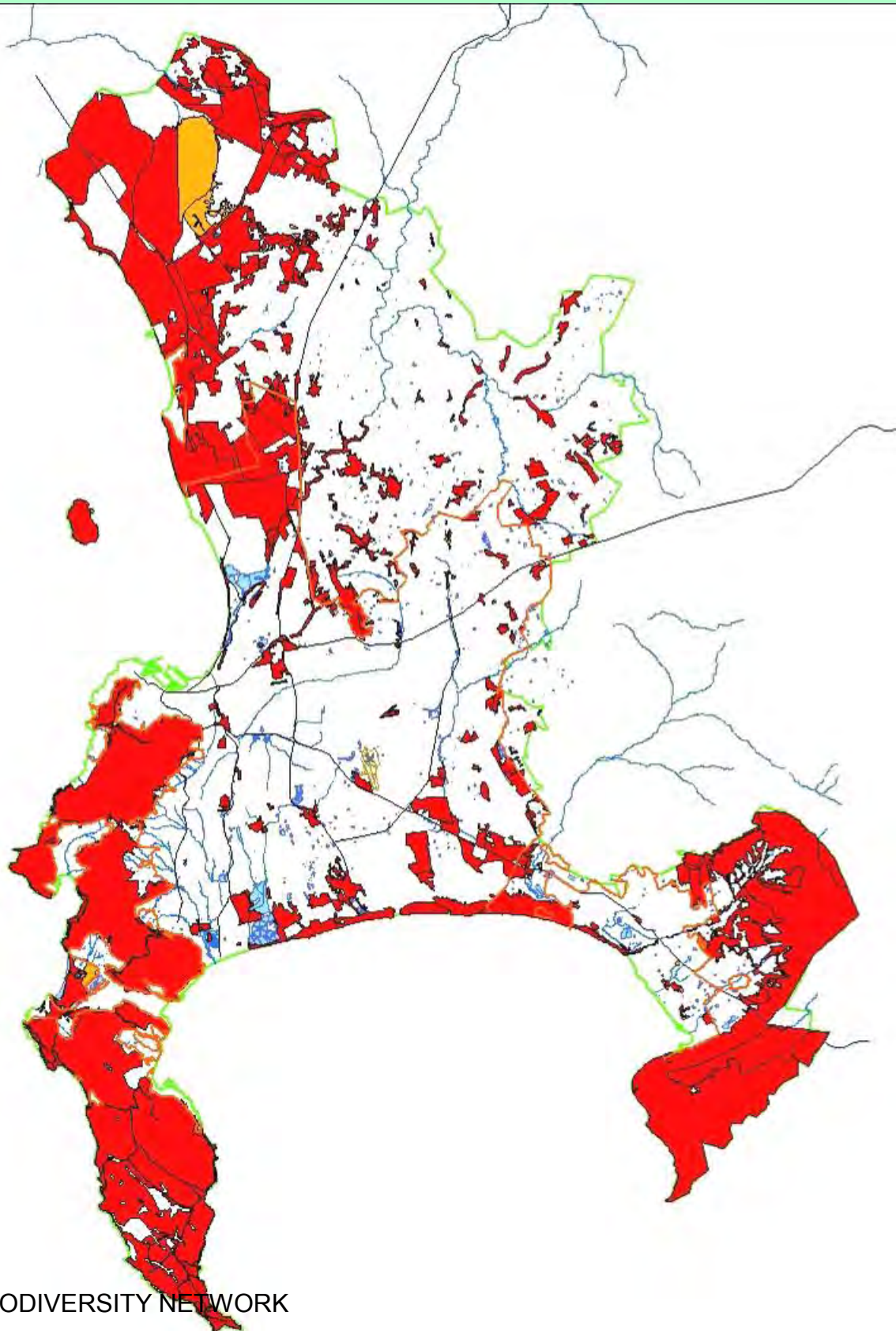
The results of this unmanaged and unplanned growth is sensitive land, like wetlands and dunes, used for development. In counteraction to improper use of land, identification of the land uses should begin with a study of the landscape and its natural processes. (McHarg, 1969).

The natural system approach to analysis could be applied at a national level. If open space areas are identified first and then fixed as planning elements, a framework can be developed to provide physical control for land use.

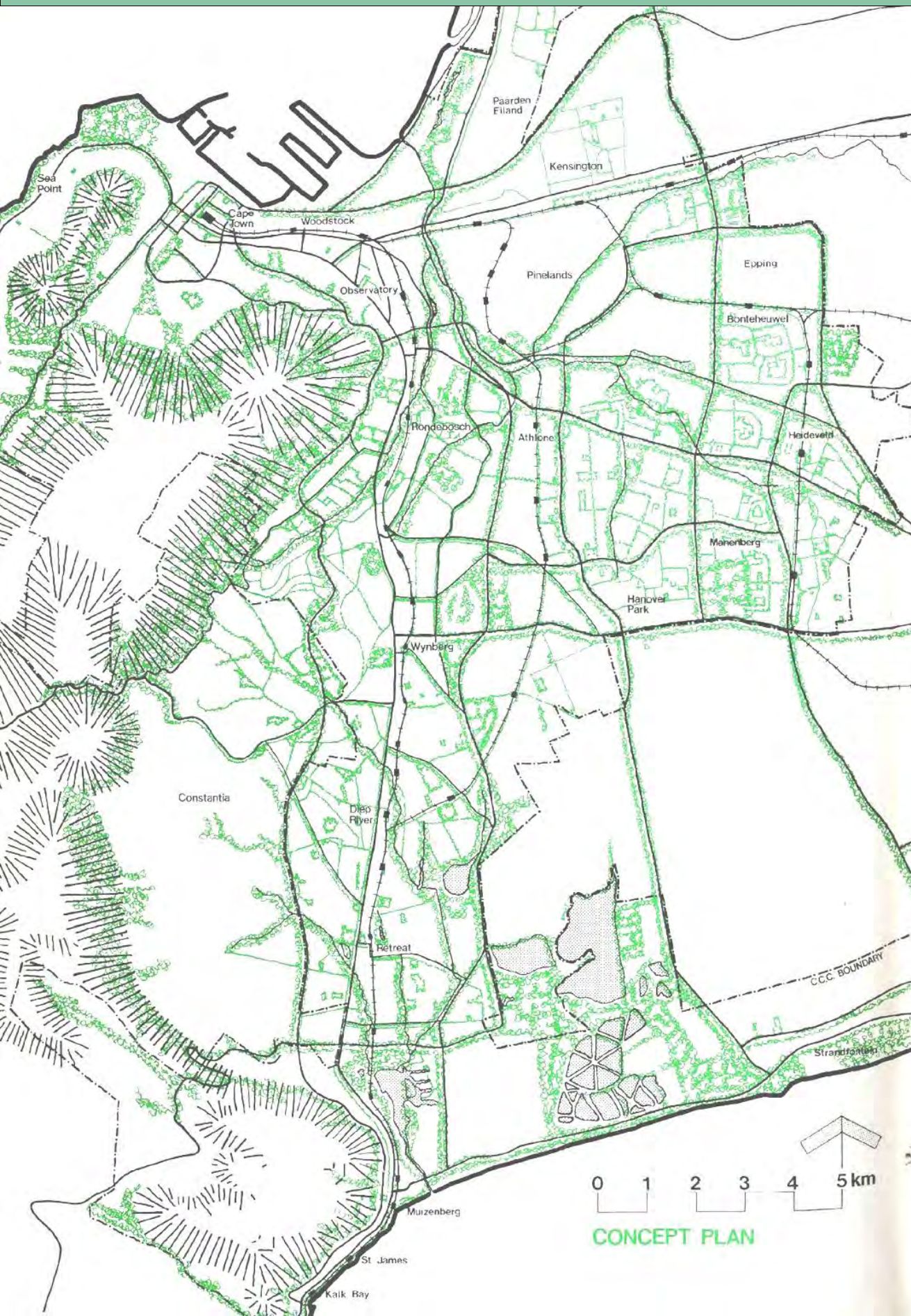
Conclusion:

Fragmented control can be attributed to the ineffective control of land development.

“Effective holistic planning is hampered by fragmented control over implementation.”
(CMOSS document, 2007;pg35)



BIODIVERSITY NETWORK
(CMOSS document, 2007;pg25)



3.1 Findings and Issues:

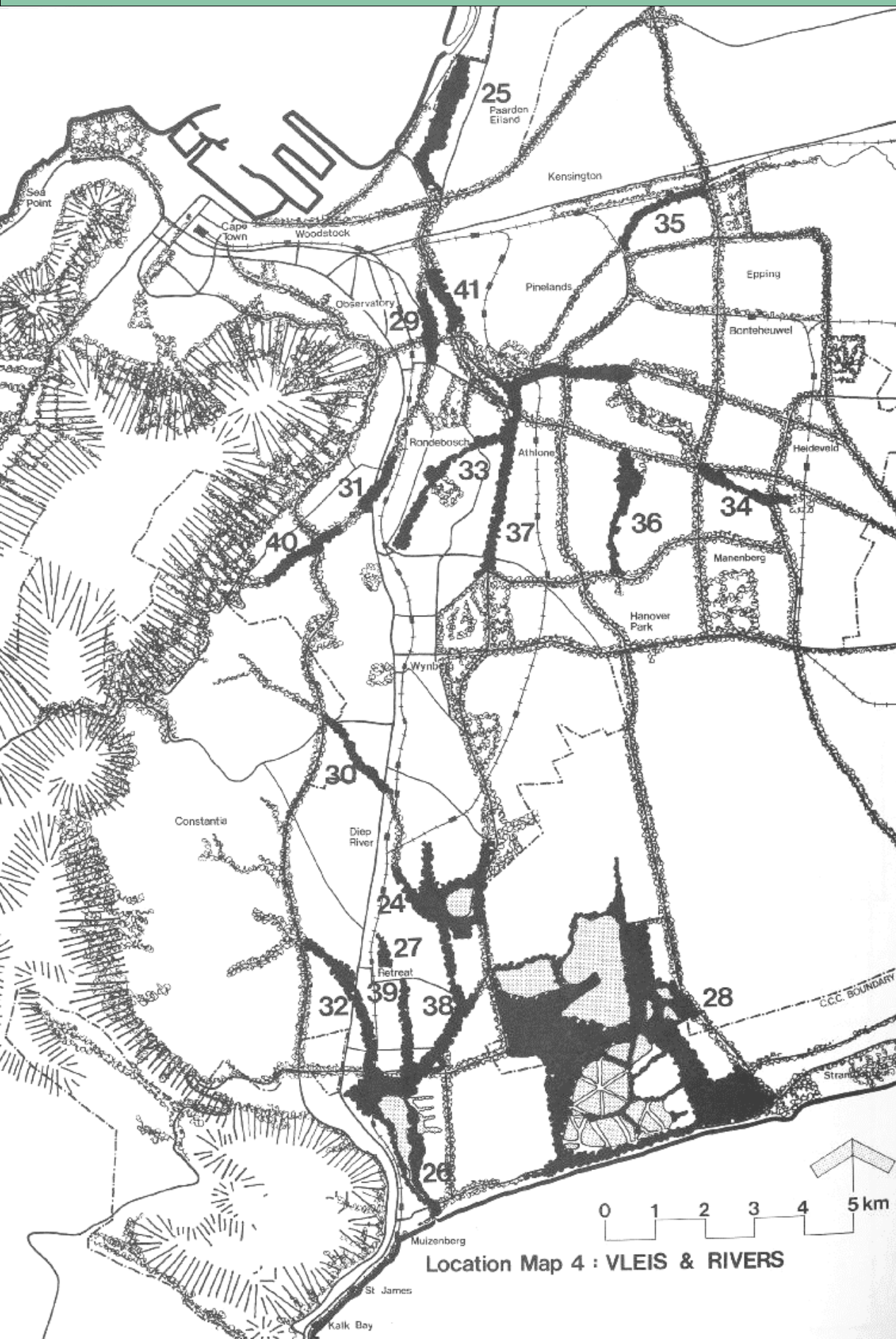
Over 40% of the population of Cape Town, reside in areas of inadequate provision of developed open space, this is predominantly in the Cape Flats area. Most of these area's however contain sufficient undeveloped or potential open space to make up for this short-fall. Factors such as quality and usefulness rather than quantity need to be considered when considering open space (City Engineers Department, 1982;pg1,15)

3.2 The Policies of Greening the City:

Conservation of ecologically valuable areas is integral to maintaining the amenity value of the natural landscape, and maximising the recreation potential of river corridors and vlei areas. Approaches to achieving this are various; landscaping the major arterial and approach routes, and protecting important scenic and historic routes, while developing a city-wide system of urban trails and greenways, for access and recreation purposes, attached to these routes. Extend the range of sports facilities and then combine these with landscaped parkland. Improve and diversify the recreational use of all parks and natural areas as well as residential, commercial and industrial neighbourhoods, and develop the range of opportunities for play and socialising within these areas. Promote and publicise the open spaces and recreation facilities to increase awareness and usage of the spaces (City Engineers Department, 1982;pg2,35,36).

3.3 Environmental Issues:

The poor utilization of the river corridors for open space and recreation purposes, results in very few landscaped parks and paths along river banks. Private ownership of river banks also restricts public access, while walls and fences create obstructions in the flood plain zone. Canalisation of rivers eliminates biotic life, accelerates stormwater discharge and reduces the rivers recreation potential. Inadequate conservation and policing of these river areas contributes to inappropriate development, illegal dumping, water pollution, excavation and filling of our rivers and vleis. The visual blemish and damage created by undeveloped open spaces, unmade sidewalks, treeless street and the lack of landscape treatment on some arterial and approach routes all contribute to a poor image of the city's environment. (City Engineers Department, 1982;pg17).



3.4 Social and Administrative Issues:

Inadequate public participation in the planning and provision of recreational facilities, results in community alienation and will contribute to the increased likelihood of vandalism. Inadequate promotion of recreation and education programmes, as well as lack of sharing of facilities and early closing of play areas through the use of fencing, results in many open space facilities being under-used or abused. Insufficient variety in facilities, and a system of supervision, may lead to an increase in the presence of a rough element which in turn will deter people from using facilities (City Engineers Department, 1982;pg17).

3.5 Opportunities for Open Space:

3.5.1 Rivers and canals

Cape Town has some 75km's of waterways which are currently largely an untapped amenity resources, and which could form part of a comprehensive open space system. Rivers such as the Liesbeeck, Black, Diep and Keyzers provide opportunities for the development of walking, cycling, riding and even canoe trails(City Engineers Department, 1982;pg18).

3.5.2 Undeveloped and vacant land

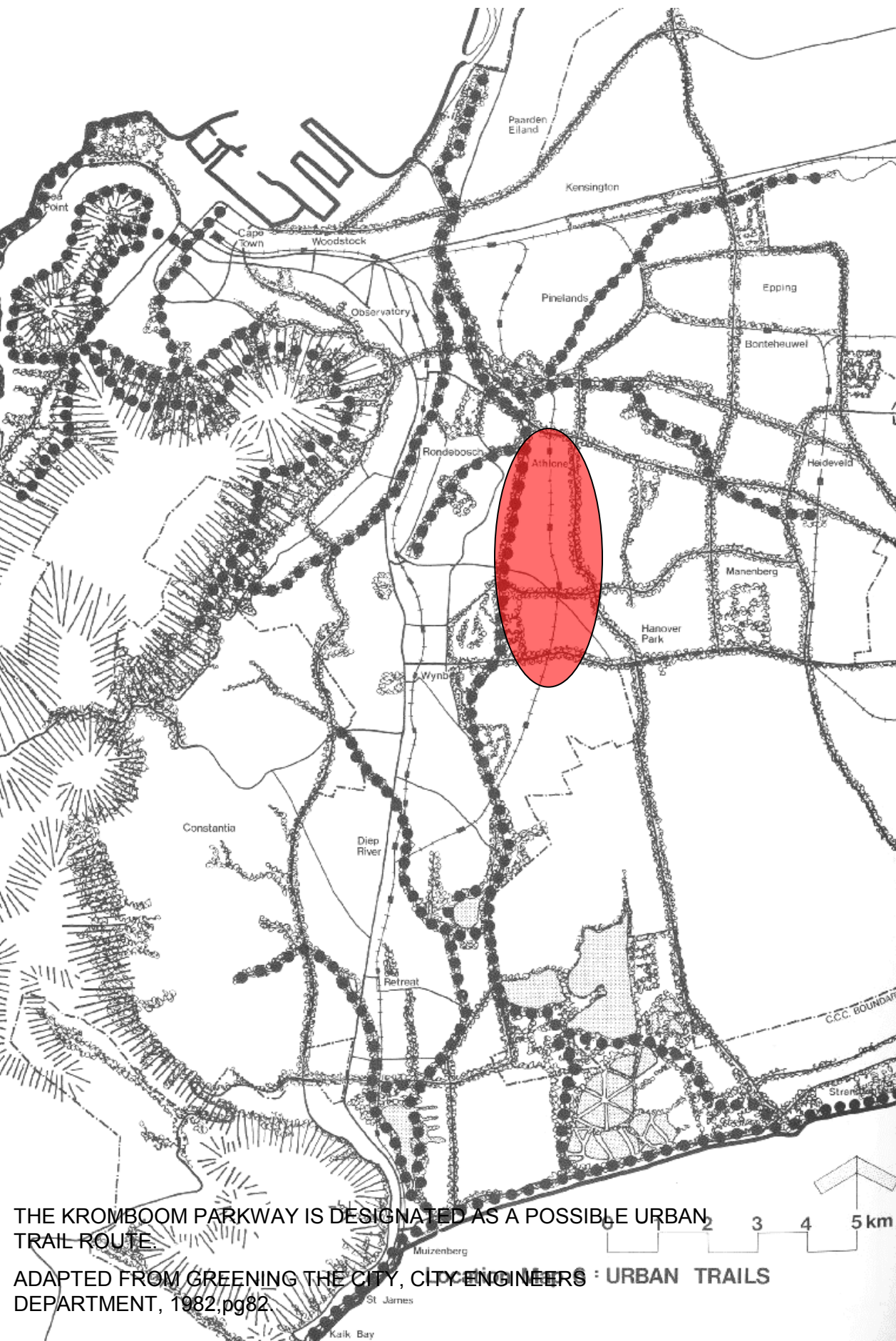
Undeveloped and vacant land in the form of open space as well as school and road-widening reserves and derelict sites, at present create a blighted effect, but could serve as valuable open space in the built up areas, or even as temporary parks or playgrounds (City Engineers Department, 1982;pg18).

3.5.3 Streets and major road verges

Streets and major road verges, being in public ownership, provide opportunities to create green spaces, in residential areas. Existing, as well as planned, arterial roads and parkways could also provide valuable linear open space, as in the case of the new **Kromboom Parkway**, which has established jogging paths and bicycle-ways. (City Engineers Department, 1982;pg18).

3.6 Open Space Survey:

1 ha of developed open space per 1000 persons was the starting point to measure the 1982 status of open space and to identify areas with shortages. 7 districts fell short of this mark, these were Parkwood, Schotschekloof, Athlone, Heideveld, Kensington, Woodstock and Lansdowne (City Engineers Department, 1982;pg19).



Planning Principles:

Each open space is part of a continuous system which forms a network across the city. A hierarchy of open space which varies from large natural areas to small neighbourhood green space exists within this network. This open space system would structure the city, providing a framework for urban growth and directing new development.

The value of the parks lie in their link to each other. The distribution, location, ease of access or lack of barriers is important in terms of visibility and accessibility. The greater the edge of the linear open space the more visible and accessible it is. Natural features such as mountains, rivers and vleis form the basis of open space configurations. Sensitive natural areas such as wetlands are conserved and incorporated, providing continued contact with nature. Re-use waste land spaces through landscaping to form new urban parks and playgrounds and using streets as open space with minor adjustments to road and sidewalk space contribute to effective use of all open space within an urban network (City Engineers Department, 1982;pg20,21).

Design and Treatment Principles:

Usefulness of open space is determined by size, shape and treatment. Scale and character should be appropriate for the site. Adequate surveillance, lighting and policing are necessities to creating public areas. Sheltered spaces with a sense of enclosure and privacy should be provided in open spaces, while orientation and legibility can be improved through landmarks, clearly marked paths, signs and sequences of spaces. A variety of spaces and mixture of various uses should be made available to encourage more public use, while facilities and spaces should be shared to ensure the optimal use of limited resources (City Engineers Department, 1982;pg22,23).

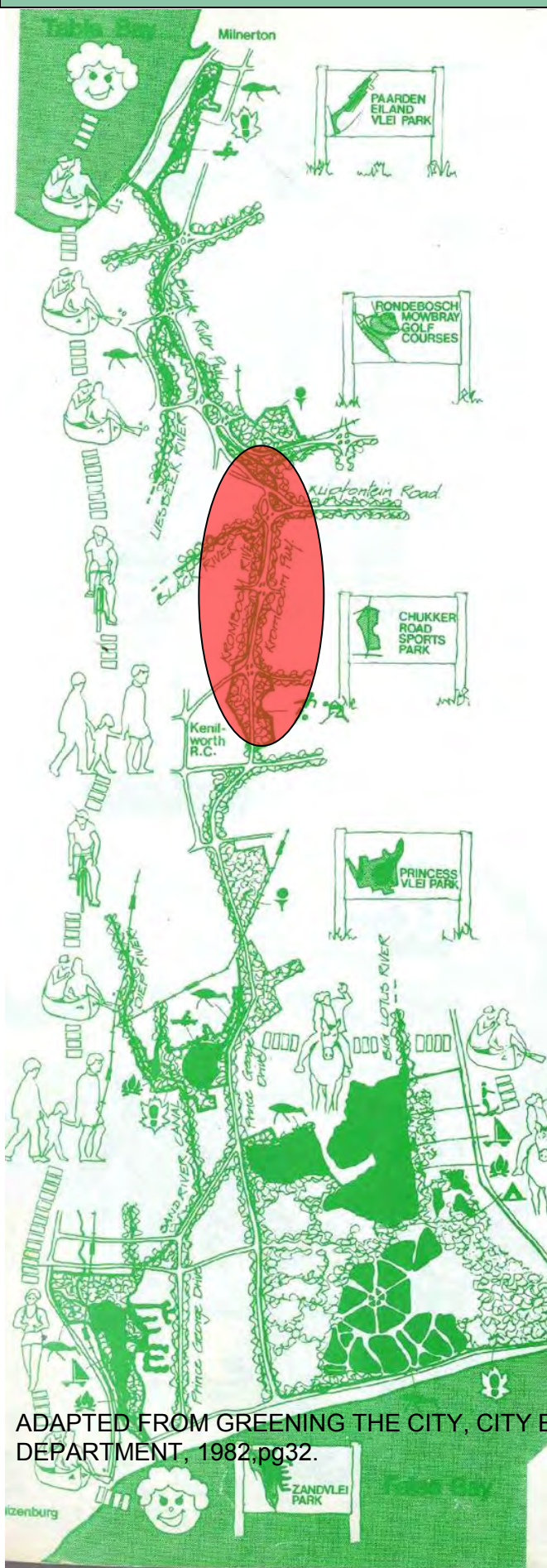
Implementation and Management Principles:

A co-ordinated approach is necessary. Implementation must be in the form of a complete package. Creation of spaces which are hardy and require little maintenance, along with carrying capacity studies and controlled access points, will help prevent deterioration through overuse. Community participation throughout is preferred, because consultation and feedback will make clear the relevant needs of the community. The open space system should be promoted and good signage improves publicity (City Engineers Department, 1982;pg23,24).

THE KROMBOOM PARKWAY IS DESIGNATED AS A POSSIBLE URBAN TRAIL ROUTE.

ADAPTED FROM GREENING THE CITY, CITY ENGINEERS DEPARTMENT, 1982,pg82.

CITY ENGINEERS : URBAN TRAILS



Landscape Framework (city scale):

A landscape framework provides major open space structure at city scale and consists of most of the natural features, large parks and sports complexes. Continuous linear parks are included where possible. Arterial roads, parkways, river corridors and urban trails are seen as major linking elements (City Engineers Department, 1982;pg27).

Landscape Web (neighbourhood scale):

Landscape web includes planted streets, playing fields, pocket parks etc. Improvement of neighbourhoods will directly benefit local residents. (City Engineers Department, 1982;pg28).

Coast to Coast Greenway:

Greatest linear park and central spine of the framework is a 'greenway' linking Table Bay with False Bay. The greenway links the coast with the Black River corridor, Kromboom Parkway, Princess Vlei, and the Rondevlei – Zeekoevlei resources. The northern end of this greenway terminates in the Paarden Eiland Vlei Park and the southern end in the False Bay Coastal Park. Which would create a system of trails that will be available to locals and tourists. The entire route would be made navigable by changing transport modes, from bicycling to canoeing etc (City Engineers Department, 1982;pg29-32). The importance of the greenway corridor is its central location in the urban settlements, which provides relatively easy access to pedestrians, unlike the mountain and sea. (E.Tilanus-thesis)

Policies and Proposals:

Rivers and Vleis:

Maximise recreation potential of river corridors and vlei areas, and improve water quality to meet recreation standards. Rather than treated as backyards, these areas should be developed and managed as positive open space amenities. Where feasible paths and landscaping should be proposed along canals such as the Kromboom, Elsieskraal, Langvlei, Vygekraal and Sand River (City Engineers Department, 1982;pg32-35).

Projects:

Rivers: Kromboom Canal: 3 km, Kenilworth Centre to Black River, Landsowne/Athlone.

Major Routes: Kromboom Parkway: 5 km, Black River Parkway to Prince George Drive, Rondebosch/Ottery.

CHAPTER 4 SITE ANALYSIS AND EXISTING FRAMEWORK



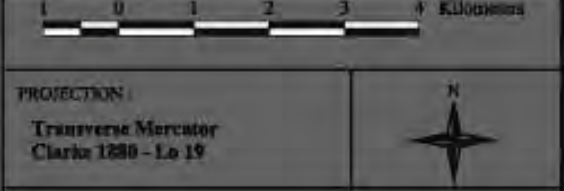
LEGEND

- Catchment Boundary
- Sub-Catchment Boundaries
- Cadastral
- Contours
- River - Unclassified

REFERENCE

Ecological Status Class (Rivers)	Ecological Importance Category
N/A 1 UNMODIFIED	High MOST IMPORTANT
N/A 2	Moderate
3	Low / Marginal MARGINALLY IMPORTANT
4	
5 SERIOUSLY MODIFIED	
6	

Waterbodies (purple line)
Erosion (yellow dashed line)
Sedimentation (yellow solid line)

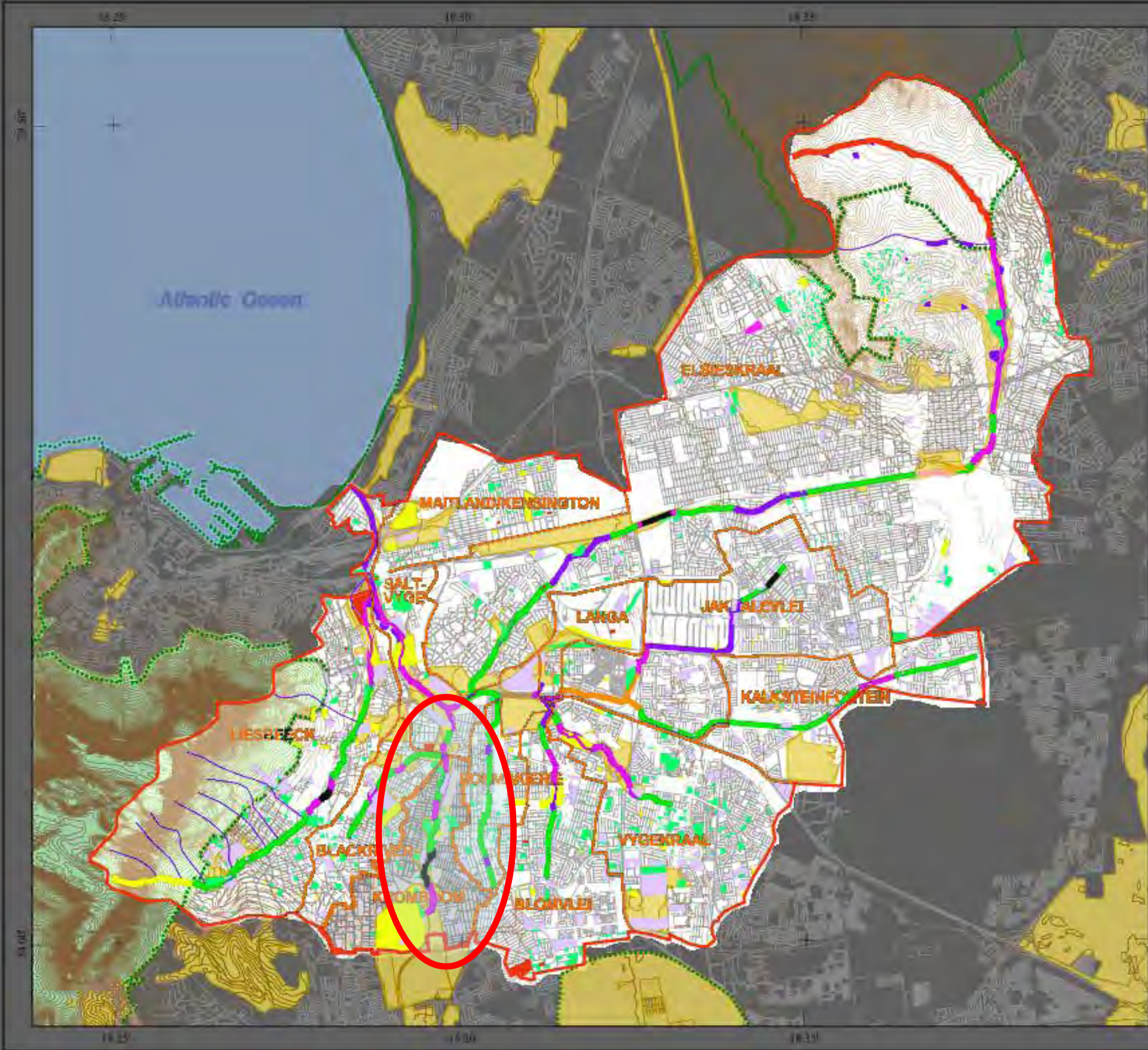


The Kromboom River is a seriously modified river and could be referred to more accurately as a stormwater channel. Currently in its present condition it has little to no ecological value, with the concrete channel unable to provide the environmental habitat variety needed to support riverine biotic life.

The Kromboom River has one stretch of approximately 500m in earth banks, starting from the rivers emergence onto the eastern side of the M5 highway. This particular stretch of the Kromboom River is experiencing severe erosion problems along its banks.

Adapted from the Salt River Catchment Management Plan – by Ninham Shand – September 2000

CHAPTER 4 SITE ANALYSIS AND EXISTING FRAMEWORK



LEGEND

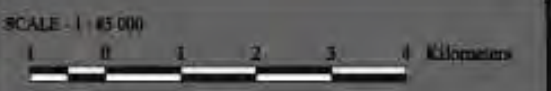
- Catchment Boundary
- Sub-Catchment Boundaries
- Cadastral
- Rivers
- Contours
- Waterbodies
- CPNP Boundaries
- MOSS Boundaries
- Urban Edge

OPEN SPACE AREAS / VACANT LAND

- Central Government
- Provincial Government
- Local Authority
- Parastatal
- Private
- Undetermined

LANDUSE ADJACENT TO RIVER

- Agriculture
- Commercial
- Industrial
- Informal Settlements
- Institutional
- Nature Area
- Open Space
- Residential
- Water Treatment Works



The Kromboom River forms part of the metropolitan open space system, although along the length of the Kromboom River as it gets closer to the Black River confluence the open space system narrows quite dramatically in points.

The landuse is quite varied, with large amounts of residential space and open space abutting the Kromboom River, while the public open spaces are intermingled with vacant sites owned by provincial government. The fragmentation of the metropolitan open space with the scattered private land ownership and the vacant sites creates a discontinuity and hampers the linkage which would exist right through the Kromboom Parkway system.

Adapted from the Salt River Catchment Management Plan – by Ninham Shand – September 2000

CHAPTER 4 SITE ANALYSIS AND EXISTING FRAMEWORK



- LEGEND**
- Catchment Boundary
 - Sub-Catchment Boundaries
 - Cadastral
 - Contours
 - Rivers
 - Waterbodies
 - Known & Potential Flood Issue
 - Stormwater Pumpstation
 - Detention Pond
 - Canals
 - Compound Canals
 - Culverts
 - Channels
 - Stormwater Pipes
 - Sewer Pumpstation
 - Run-of-River Abstractions
 - Known & Potential Loading
 - Major Potable Water Users
- SANITATION LEVELS (Areas not on waterborne sewer system)**
- Bucket Toilets
 - Container Toilets
 - No Service Yet



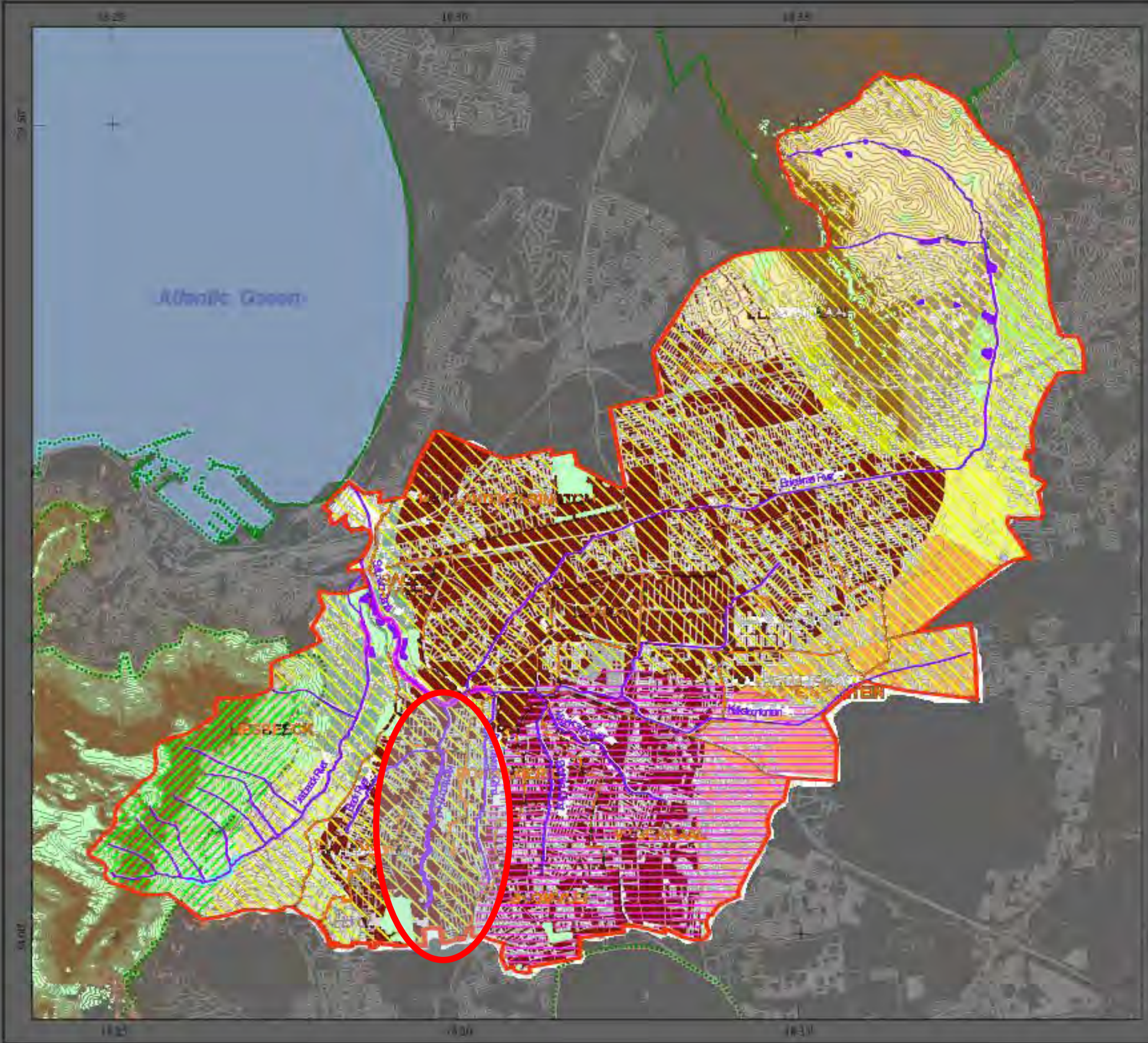
The Kromboom River has its birth in the detention ponds in the Kenilworth Racecourse. Most of the stormwater runoff which is piped into the Kromboom River originates from the south-western side of the river, from the areas around Kenilworth Centre shopping mall and Access Park commercial park.

There are no sewer pump stations along the Kromboom River and the rest of the stormwater comes from the surrounding neighbourhoods of Rondebosch, Lansdowne and Athlone.

There are some potable water users, but essentially the Kromboom River water is not of good enough quality to drink untreated.

Adapted from the Salt River Catchment Management Plan – by Ninham Shand – September 2000

CHAPTER 4 SITE ANALYSIS AND EXISTING FRAMEWORK



LEGEND

Catchment Boundary	Rivers
Sub-Catchment Boundaries	Contours
Cadastral	Waterbodies

SOILS

- Clayey residual soils
- Deep aeolian and alluvial sand
- Deep calcareous sand
- Gritty sand
- Sandstone and scree
- Shale rock and residual soils
- Shallow sandy soils underlain by clay
- Thin loamy soil underlain by residual shale
- Thin mixed loamy soil underlain by clayey residual shale
- Thin mixed loamy soil underlain by shallow residual shale

GEOLOGY

- Malmesbury Group
- Table Mt. Group
- Various Coastal Deposits

VEGETATION TYPES

- Nature Conservation Areas
- Agricultural Areas

FAUNA

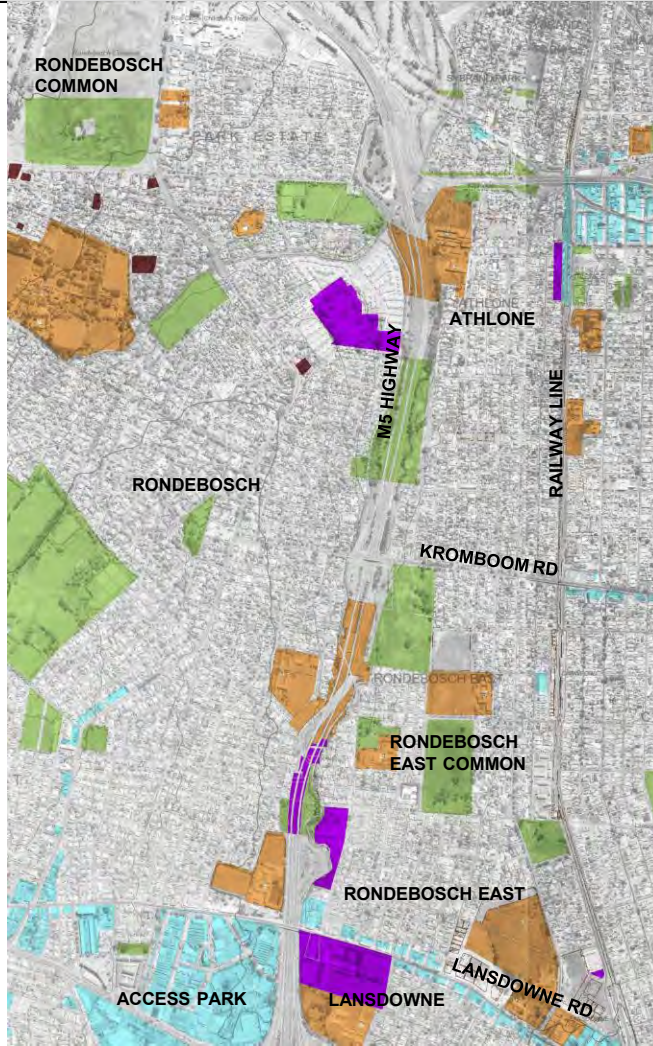
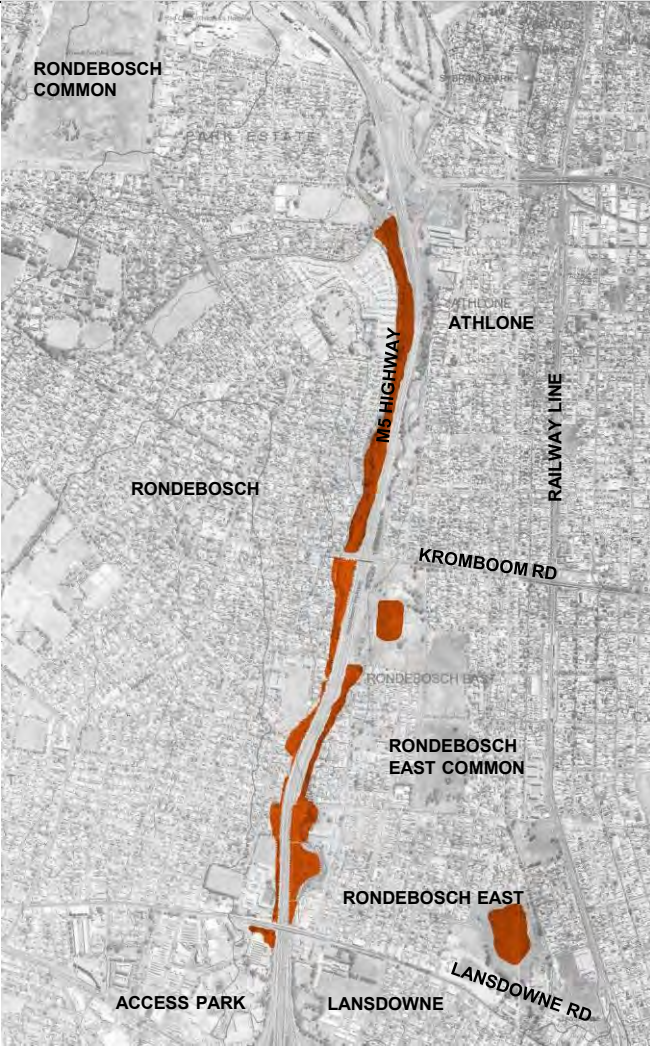
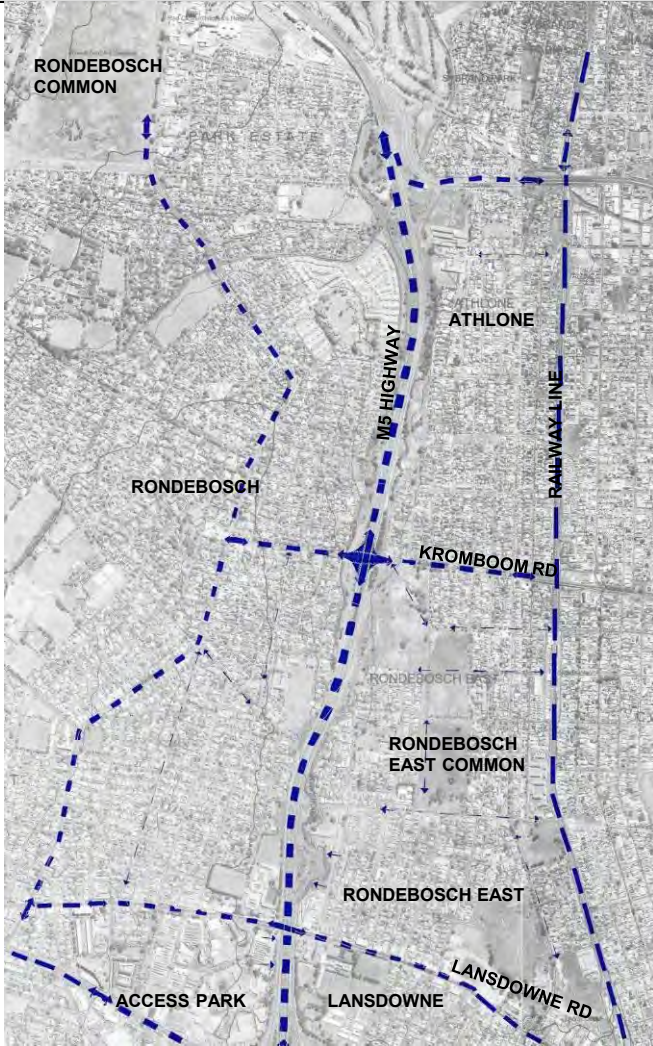
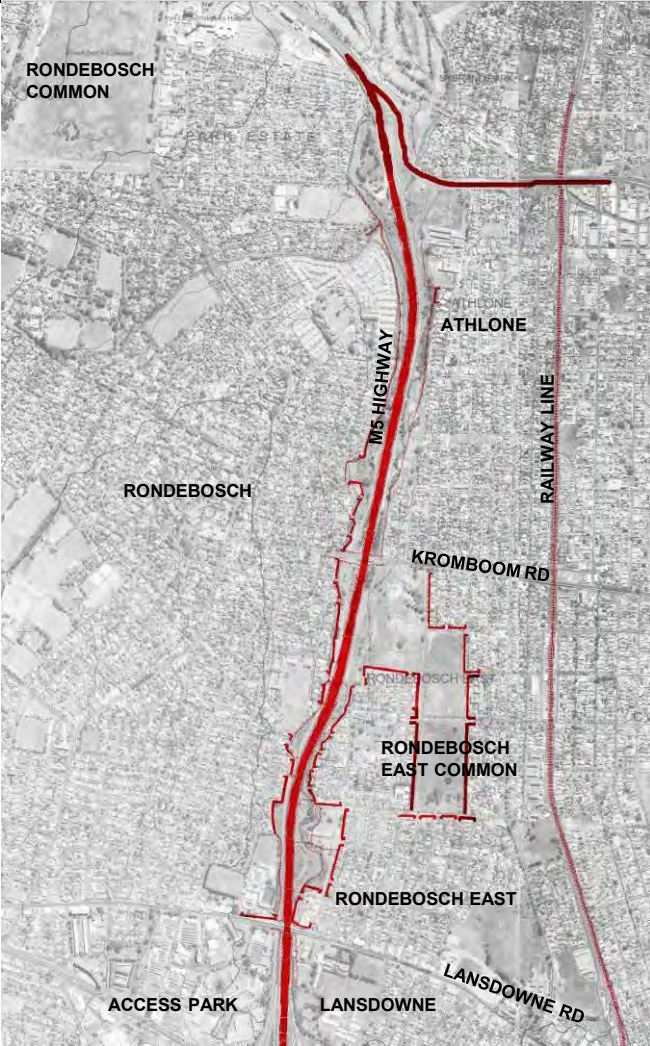
- Beds
- Fish



PROJECTION :
Transverse Mercator
Clarke 1880 - Lo 19

The Kromboom Parkway has its foundation on Malmesbury Shale rock and deep aeolian and alluvial soils. Agriculture is a possibility, but the factor of available space would hamper such activities at a large scale. The introduction of any new vegetation should thrive. At present there is a large community of alien vegetation growing in the Kromboom Parkway, most notably Gum, Pine and Poplar trees. There are no notable conservation areas, although the site on the corner of the Kromboom bridge and the M5 has the potential, but is currently not zoned as public open space nor as a conservation area.

Adapted from the Salt River Catchment Management Plan – by Ninham Shand – September 2000



COMMERCIAL	INSTITUTION
PUBLIC OPEN SPACE	HERITAGE
EDUCATION	

Attractors:

The activities most likely to attract people to an area are those of public open space, institution, education, heritage, commerce, industry, civic and public utility. A significant amount of attractor functions are situated alongside and around the Kromboom Parkway, most within the 400m distance comfortably walked by pedestrians. These attractors share no common link or coordinated system of relationship to each other.

Barriers:

The Kromboom Parkway is divided into western and eastern sides by the M5 Highway which acts as a major barrier. The properties abutting the Kromboom Parkway on either side have taken a stance of zero tolerance to the crime and vagrancy which is prevalent in this area, and have fenced off their plots, creating a zone of very limited access. The only entrances or exits are at the northern and southern ends of the Kromboom Parkway. The barriers of wall and fence and highway have made Kromboom Parkway an unsafe place to be, with poor visibility and no escape routes.

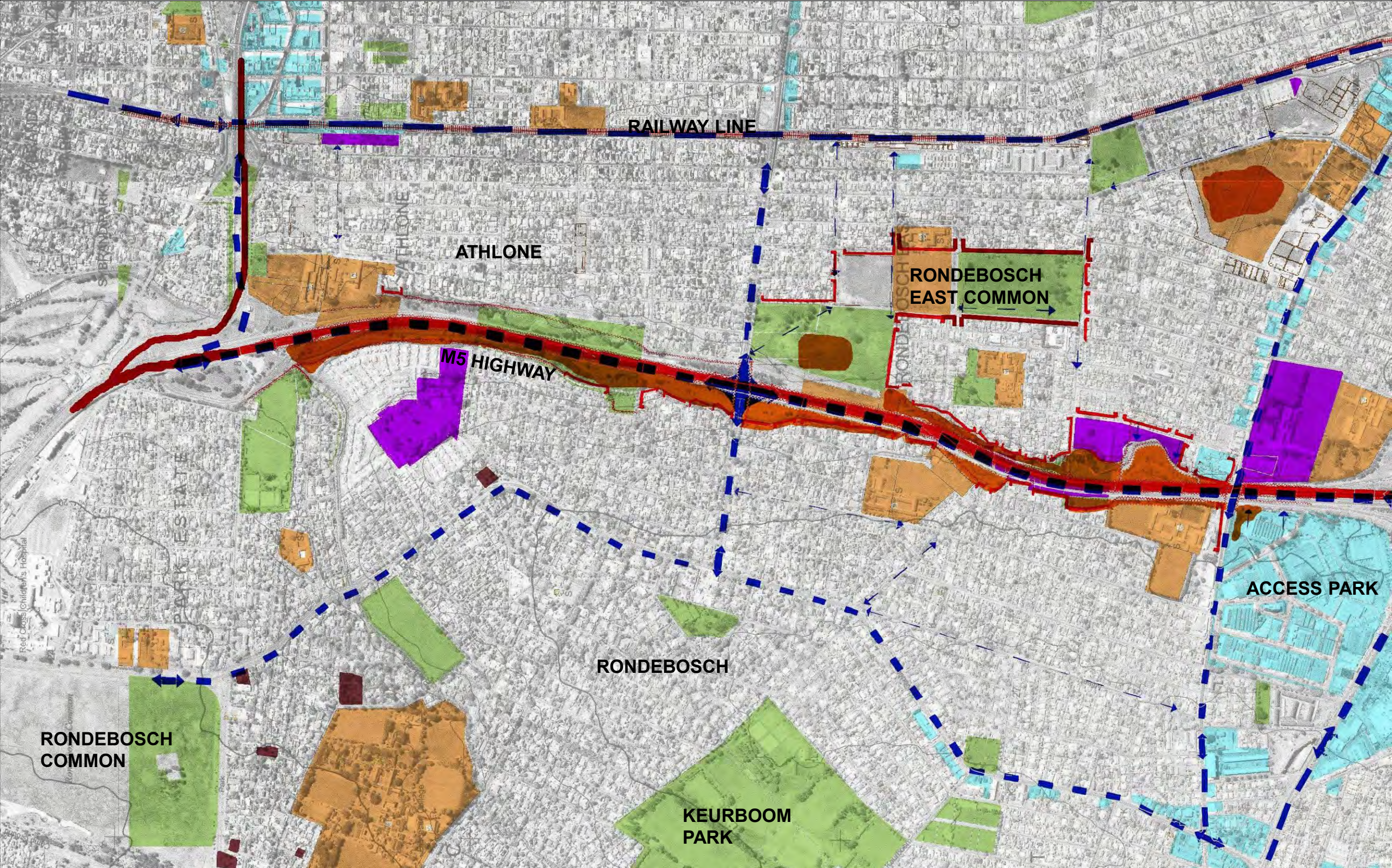
Movement:

The major movement route is the M5 highway, which funnels traffic at high speeds but allows little interaction with the surrounding urban fabric, and is impassable for pedestrians, except at Kromboom bridge and Lansdowne bridge.. Pedestrian movement is largely confined to either side of the M5 highway. Movement routes into the Kromboom Parkway itself are few in number and small in scale, mostly in the form of urban residential cul-de-sacs. Movement from one space to another within the Kromboom Parkway is complicated by barriers and safety issues.

Safety:

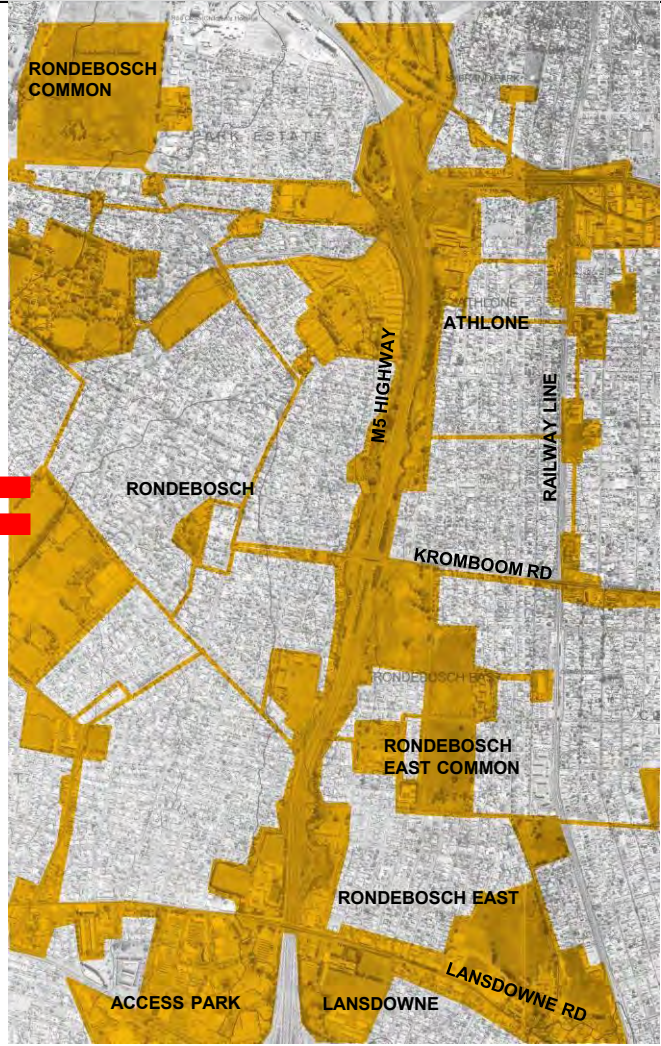
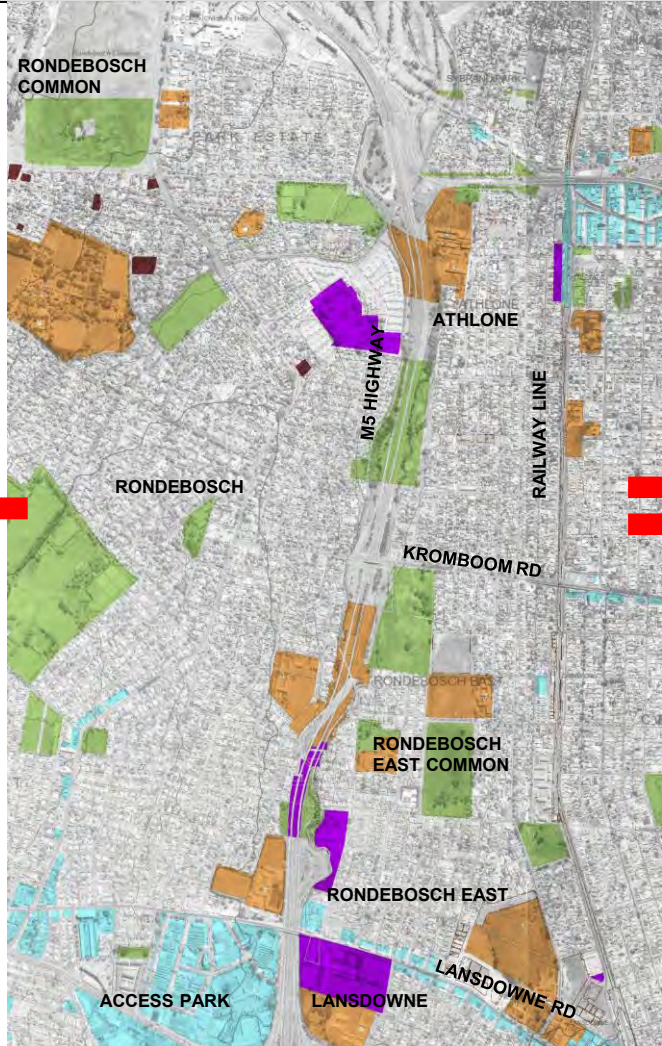
The areas of poorest visibility and most restricted access are the most dangerous places for crime. Most of the Kromboom Parkway has very restricted access except at the northern and southern ends and visibility is poor from the residential areas on either side because of the policy of fencing off the public open space. There is visibility onto the M5 highway, but that is of little benefit as motorists are unlikely to see anything at that speed, or indeed are unlikely to stop to assist.

CHAPTER 4 SITE ANALYSIS AND EXISTING FRAMEWORK



	COMMERCIAL		INSTITUTION
	PUBLIC OPEN SPACE		HERITAGE
	EDUCATION		BARRIER
	SAFETY		MOVEMENT

The combination of attractors and movement shows that routes to and from attractors have no relation to where they are in relation to each other, but rather follow the route designated to bypass the existing barriers, making travel from one attractor to another greater in distance and duration. Unfortunately this applies to pedestrian or any other mode of transportation as well. The greatest need for movement routes lies through the Kromboom Parkway in both a north-south and east-west direction. This also coincides with the area of greatest danger. Increased pedestrian traffic due to open linkages through the Kromboom Parkway would lower the possibilities of crime in this area.



Green System:

Light Green	PRIVATE OPEN SPACE
Dark Green	PUBLIC OPEN SPACE
Red	LANDUSE PUBLIC OPEN SPACE ZONING = NO FUNCTION AS YET

Attractors:

Cyan	COMMERCIAL	Purple	INSTITUTION
Light Green	PUBLIC OPEN SPACE	Brown	HERITAGE
Orange	EDUCATION		

When Attractor areas are combined with the green system the result is a spiderweb system of all the functions in an areas which serve a purpose other that residential. By linking these spaces along certain logical routes an interwoven public open space system is created.



Kromboom Parkway System Of Public Activity:

The linkages between attractor spaces and the public open space are vital in their role of giving orientation, legibility and connectivity to the system of activity spaces. If there were no barriers to pedestrian movement, all of the spaces would be reachable through walking along the various routes, most of the spaces not more than a few hundred metres from each other. Suburbs which previously turned in only one direction to access public open space would now be surrounded by it.




Residential Fabric:

The residential fabric presents a much more organised and compact form than the public open space system, but viewing the residential space in isolation the realisation is that nowhere is there a location buried so deeply within the residential that a walk of a few hundred metres would not suffice to access the system of public activity if it existed. Currently the same does not hold true for the public open space system, as the barriers in place prevent access on a large scale and the non-maintained nature of some of the public open spaces is not conducive to enjoyment.

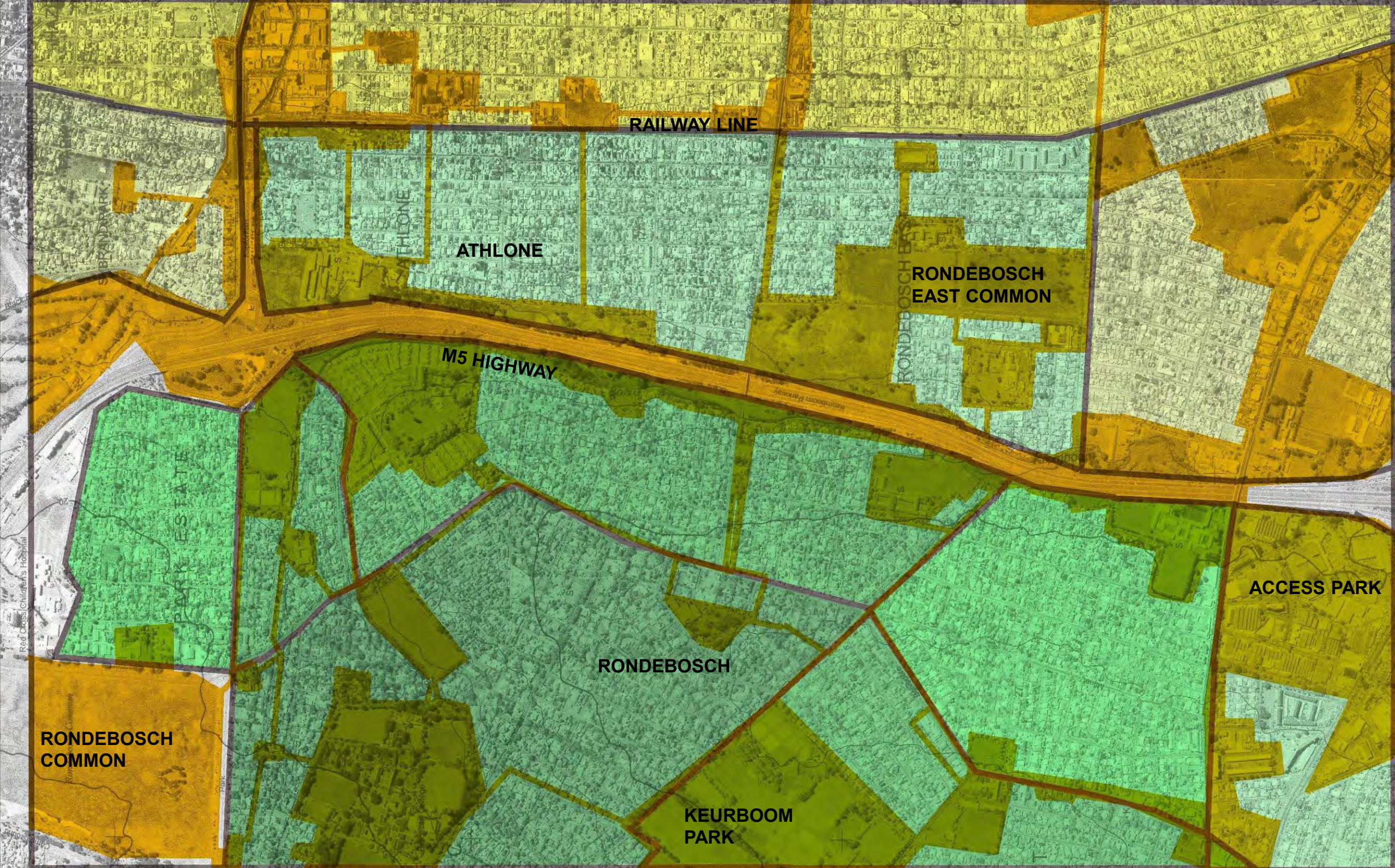
The Kromboom Parkway forms a core of public open space, which has areas of private open space and areas not zoned for open space but, serving that function attaching onto it. The Green system seems fragmented, in that the linkages between spaces are not apparent. There does seem to be a large amount of open space available in the overall context of the areas surrounding the Kromboom Parkway, but if not all the spaces are functional and some are inaccessible then that creates a very different picture.



The combination of attractors, public open space and private open space when overlaid onto the existing residential fabric reveals the possibility of a system of spaces within easy reach of all residents of the different areas. The linkages between spaces play a major role, as they could form recreational street spaces in their own right, as well as increasing the accessibility to other spaces on the activity system.

	RESIDENTIAL
	SYSTEM OF PUBLIC ACTIVITY
	

23



The system of public activity with possible linkages, when overlaid onto the divided neighbourhood fabric, reveals an opportunity to break down existing non-physical barriers with increased movement and interaction between neighbourhoods. Activity spaces would be more accessible in the overall context, would see greater usage and be shared amongst a greater portion of the population. This increased accessibility and equity of use would improve safety of the activity spaces and routes. The overall effect would be a unifying of the disparate suburban areas around the core of the Kromboom parkway and tied together by the linking elements.

	HIGHEST RATING
	LOWEST RATING
	SYSTEM OF PUBLIC ACTIVITY



The site lies adjacent to the M5 highway on the western edge, with a mixture of industry and residential on the southern edge and the Rosedone House for people with disabilities on the northern edge.

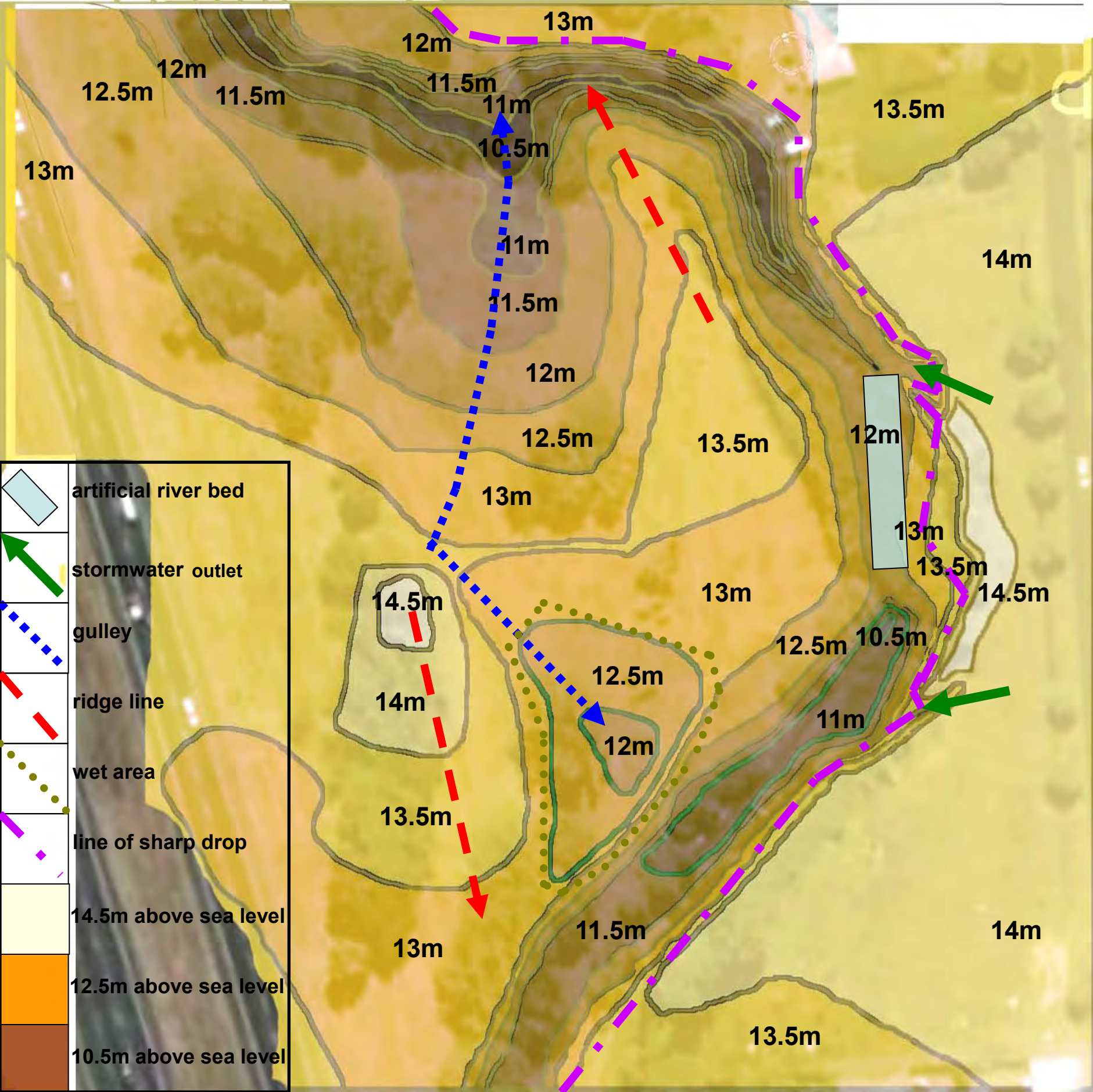
The functions of the site are unclear. The zoning is public open space on the highway edge and private open space on the eastern edge. The Kromboom River is canalised along its entire length, except for the brief distance that it runs through the site, where it has earth banks. The attempt has been made to develop a park like space, but poor maintenance and safety problems make it unusable for that purpose.

The site is currently used as overflow parking for the surrounding neighbourhood, as well as a dump for rubble.



ROSEDON HOUSE FOR THE DISABLED

CONTOUR PLAN

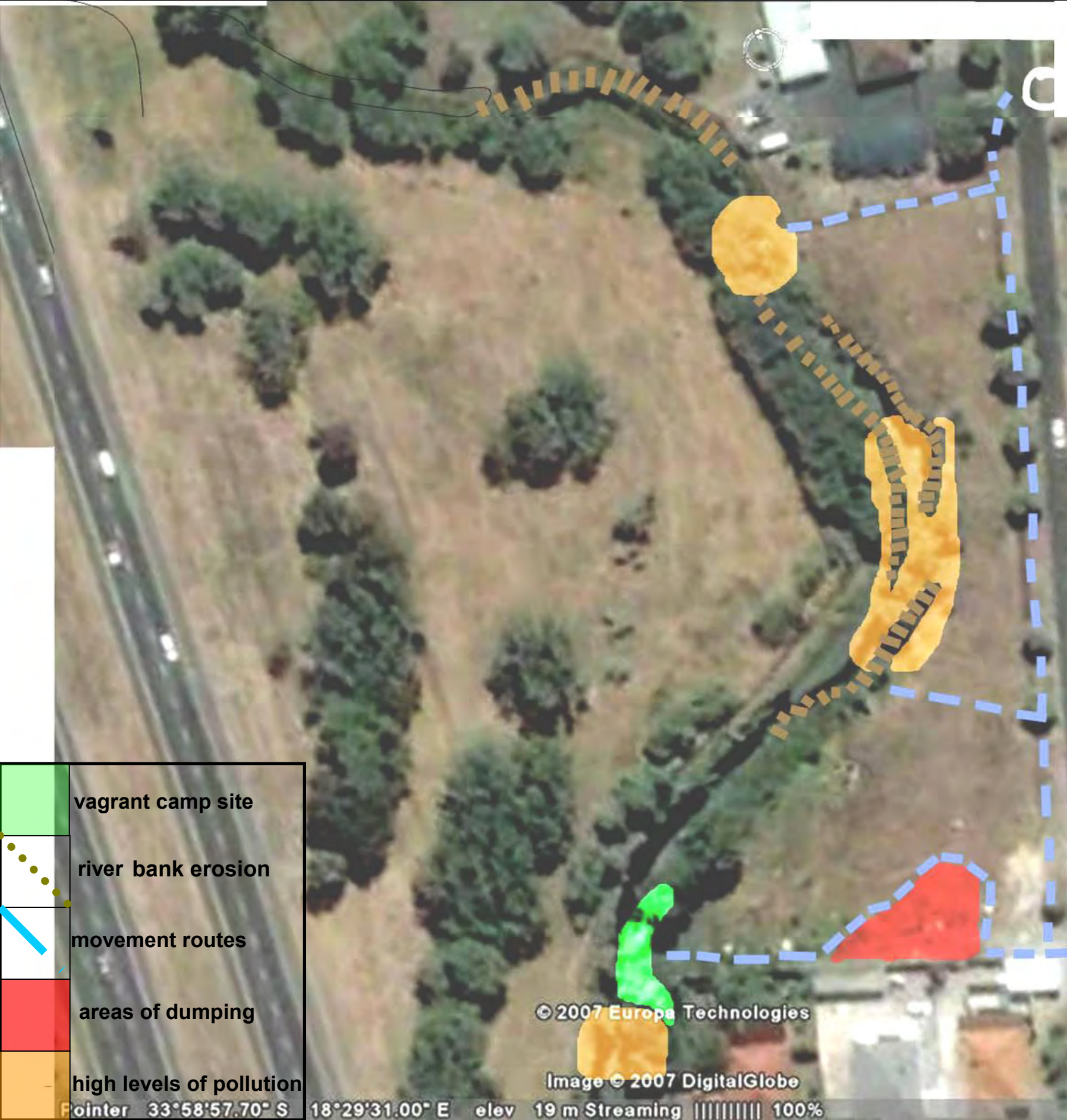


The site has a large relatively flat area on the eastern edge of 14m above sea level, before a sharp 2 metre slope down to a valley in which the Kromboom River flows. This is an artificial river bed to prevent erosion from the stormwater outflow. The Kromboom River gets deeper on either side of the artificial river bed.

The M5 highway adjacent to the site is on an average of 14.5m above sea level and the slope drops down gently towards the Kromboom River.



The steep banks on the river edge and the erosion creating even steeper slopes



The site has two main pedestrian footpaths on the northern and southern urban edges. These pathways do not extend past the river due to the fencing on the other side of the Kromboom River as well as the steepness of the slope down to the river which makes it inaccessible for some.

The areas of pollution on the site are those where the fences partially cross the Kromboom River, trapping large amounts of litter. The artificial river bed between the stormwater outlets traps litter when the water is low due to its raised bed level. A well established vagrant camp site on the extreme southern end of the site where the Kromboom River enters the site is also largely responsible for the pollution problem

The River banks are being eroded away at various points, partly due to incorrect methods of stabilising the river bank, and because of insufficient stabilising vegetation on the steep slope down to the river.

The site has been used for dumping in the recent past, despite notices banning dumping. The dump area is on the industrial/residential edge and could be from the adjacent property, the rubble simply thrown over the fence. The dump site consists of mostly builders rubble.





The fencing along the west edge of the river and crossing the river at two points effectively closes divides the site into two parts. The western, natural, unused side and the eastern, urban, poorly used side. The M5 highway creates a barrier of its own on the western edge.

The highway edge experiences a great amount of noise pollution due to passing traffic. The existing stands of trees create an effective noise and visual buffer for the rest of the site.

The areas of poorest visibility and thus greatest danger are those in amongst the trees hidden from view, down in the river channel behind the Rosedon House institution and behind the residential/industrial edge on the southern end of the site.





The southeaster is the predominant wind, blowing into the site most strongly from the southern urban edge. The residential/industrial properties on the southern edge afford good wind shelter.

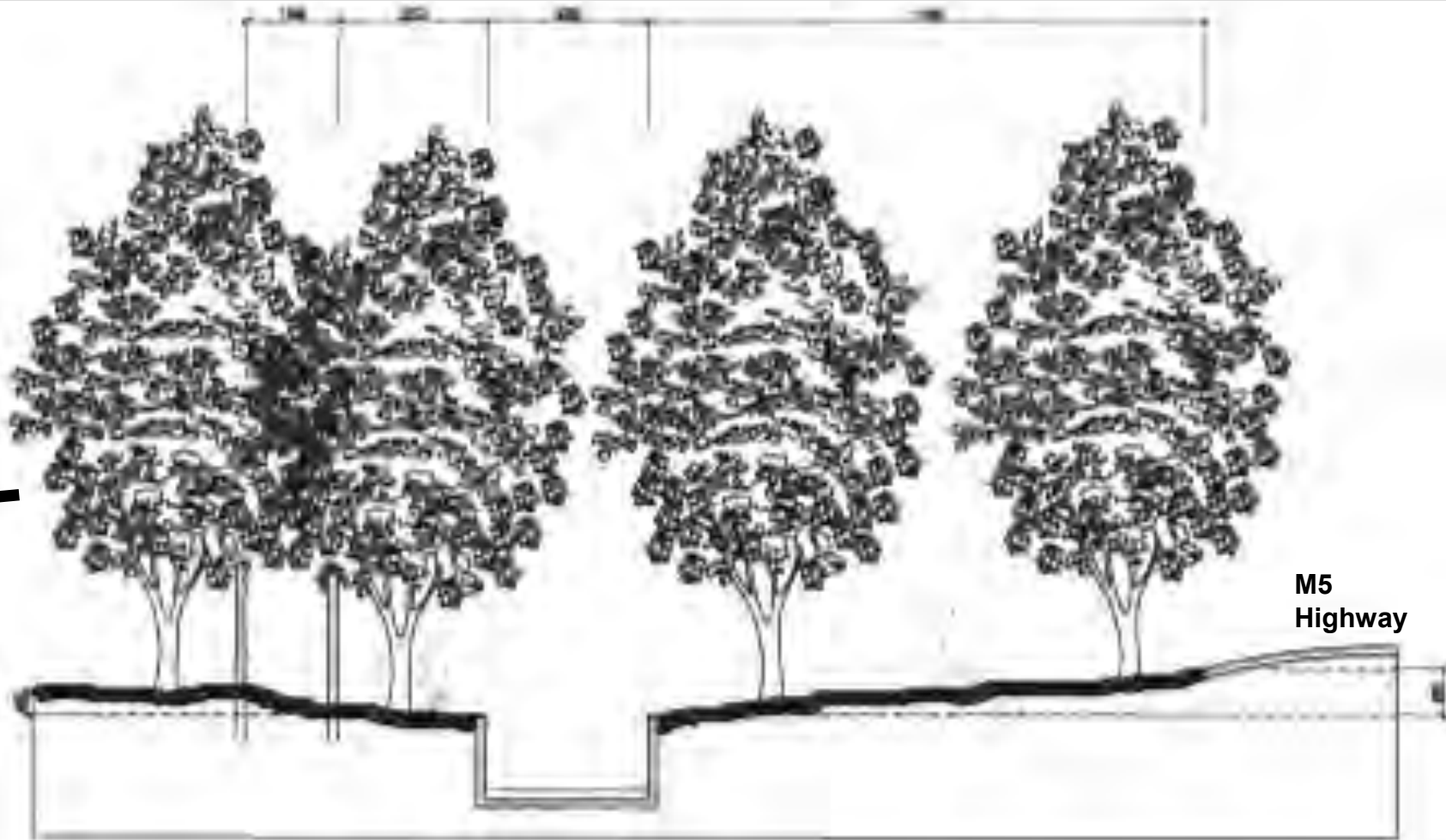
The sharp drop in height from the urban edge of the site down into the Kromboom River channel creates a sheltered space which is lengthened due to the trees on the western bank which help to dissipate the wind. Large stands of trees form good windbreaks further into the site.



The line of Poplar trees providing protection from the wind

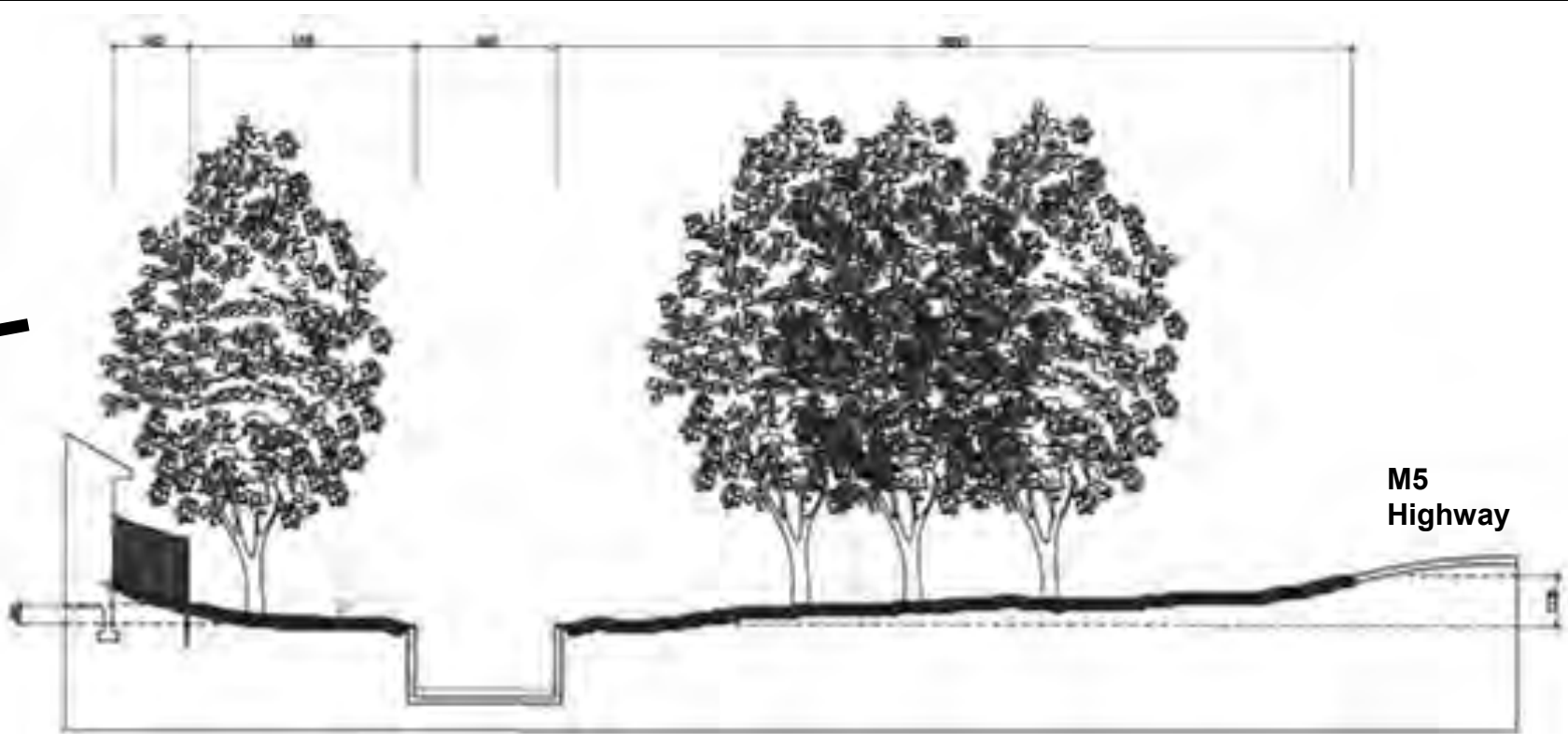


EXISTING SECTIONS



This particular stretch of the Kromboom Parkway has major potential for pedestrian and bicycle trails, with the possibility of canoe trail as well. Either side of the Kromboom River provides good shelter from the wind with frequent medium to large trees at regular intervals. Although the greater open expanse is on the M5 highway side of the Kromboom River, it would be best if the pathways were placed along the urban edge to help distance pedestrian movement from the danger posed by traffic and the noise pollution. One could also berm the edge of the M5 highway or create a haha to screen visual and noise pollution and then a pathway on the highway side would be more feasible. The slopes of the banks down to the river edge are gentle and require no great alteration. The highway side of the Kromboom River is a possibility for breaking the concrete canal wall and creating a more stepped profile to the edge.

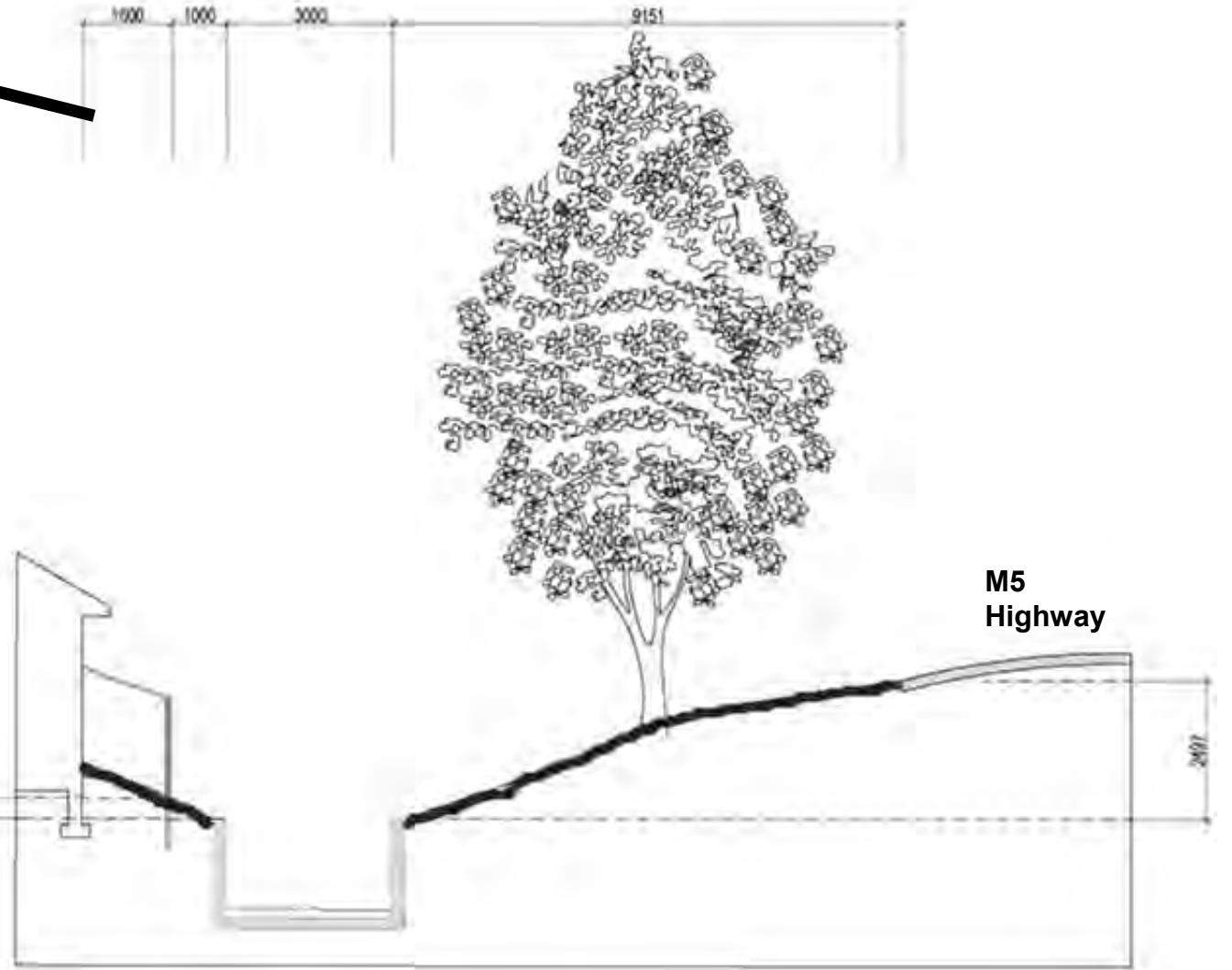
EXISTING SECTIONS



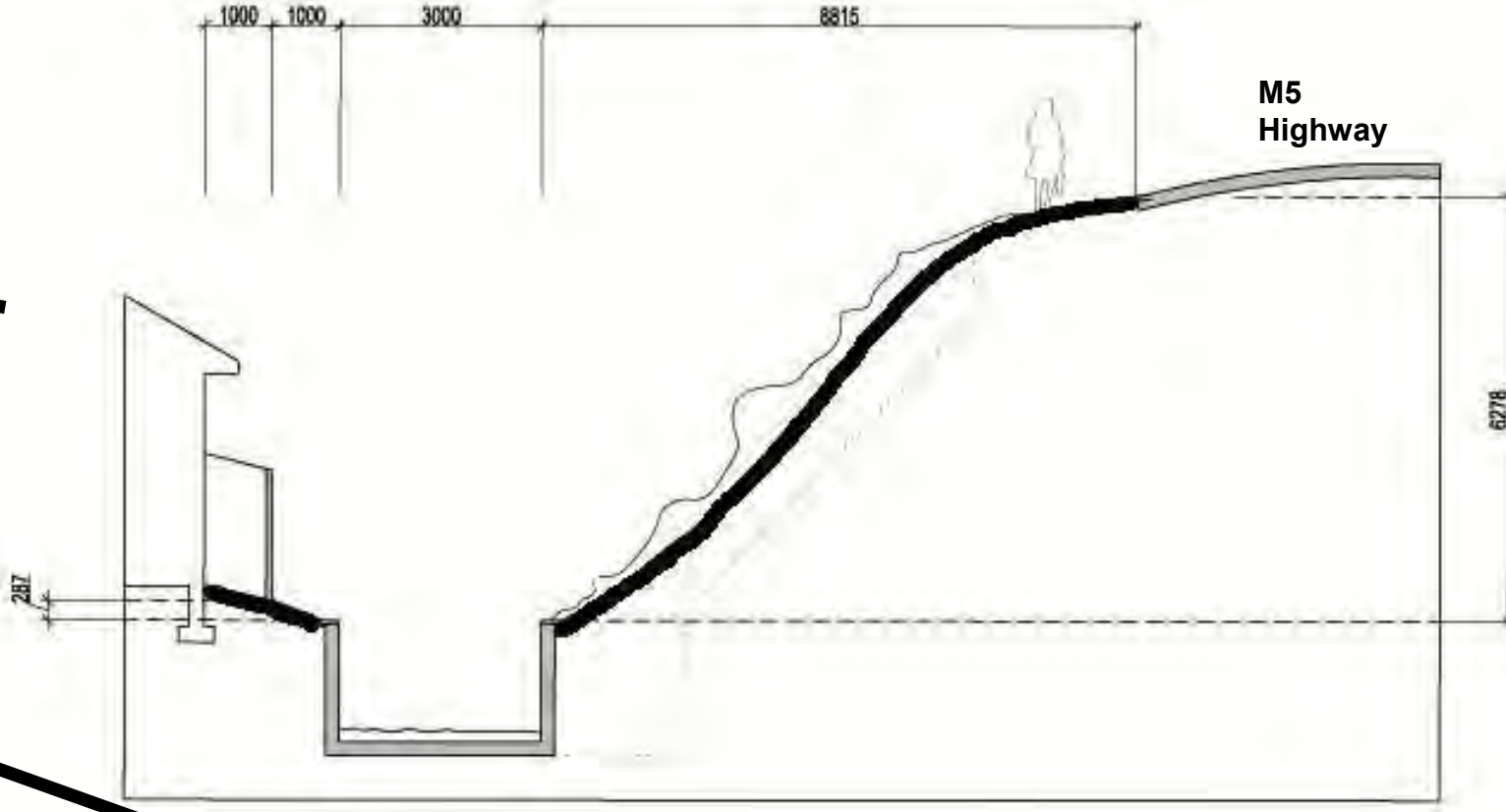
The section above shows a part of the Kromboom Parway with great potential for amenity on the highway side of the Kromboom River. The space afforded on the urban edge is sufficient for a trail, but the larger space on the other side of the Kromboom River has the potential for activities like braai's and play equipment. The stands of large trees provide welcome shade and wind protection, although not many trees occupy this space. This space would serve as a kick about field.



The section below shows a rather steep bank adjacent to the highway, which would require some retaining or cut and fill to make hospitable for trails. The urban edge is too narrow to allow for any intervention. The possibility exists of breaking the concrete channel on the highway side.



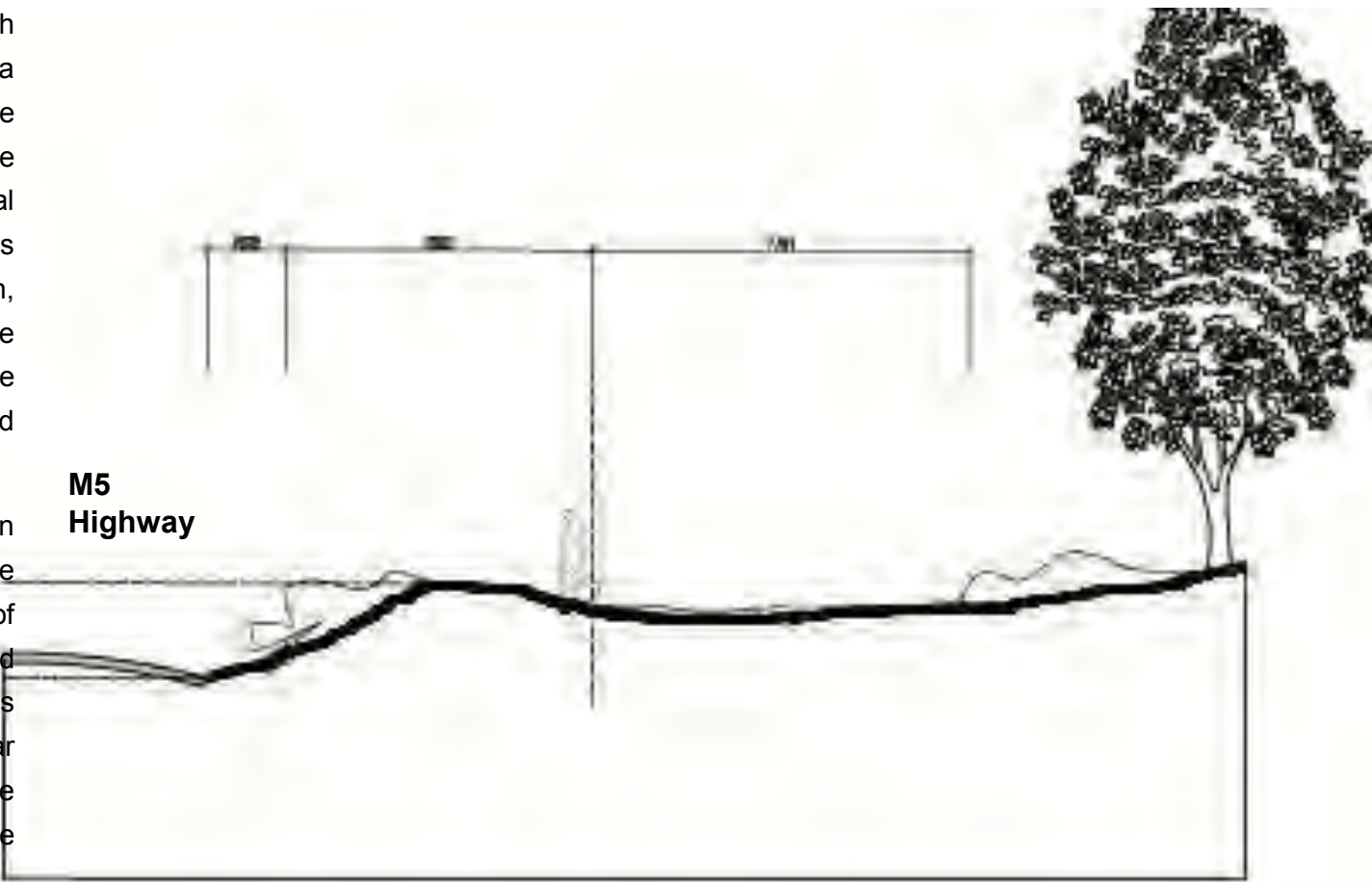
EXISTING SECTIONS



The section above shows a very steep slope adjacent to the M5 highway, not suitable for trees or any activity, but with some retaining and a low wall a pathway could be made adjacent to the highway, with dense vegetation on the highway edge for protection from visual and noise pollution. The urban edge is too narrow for any intervention, although the residential edge should be opened up to provide views into the Kromboom Parkway which would increase safety.



The section below reveals how an undeveloped open space can dissipate the sense of legibility and orientation of a route. The space is vast, open and undefined. Fairly flat with enormous conservation potential, but a clear sense of where movement takes place is needed. Possible berming on the highway edge required.



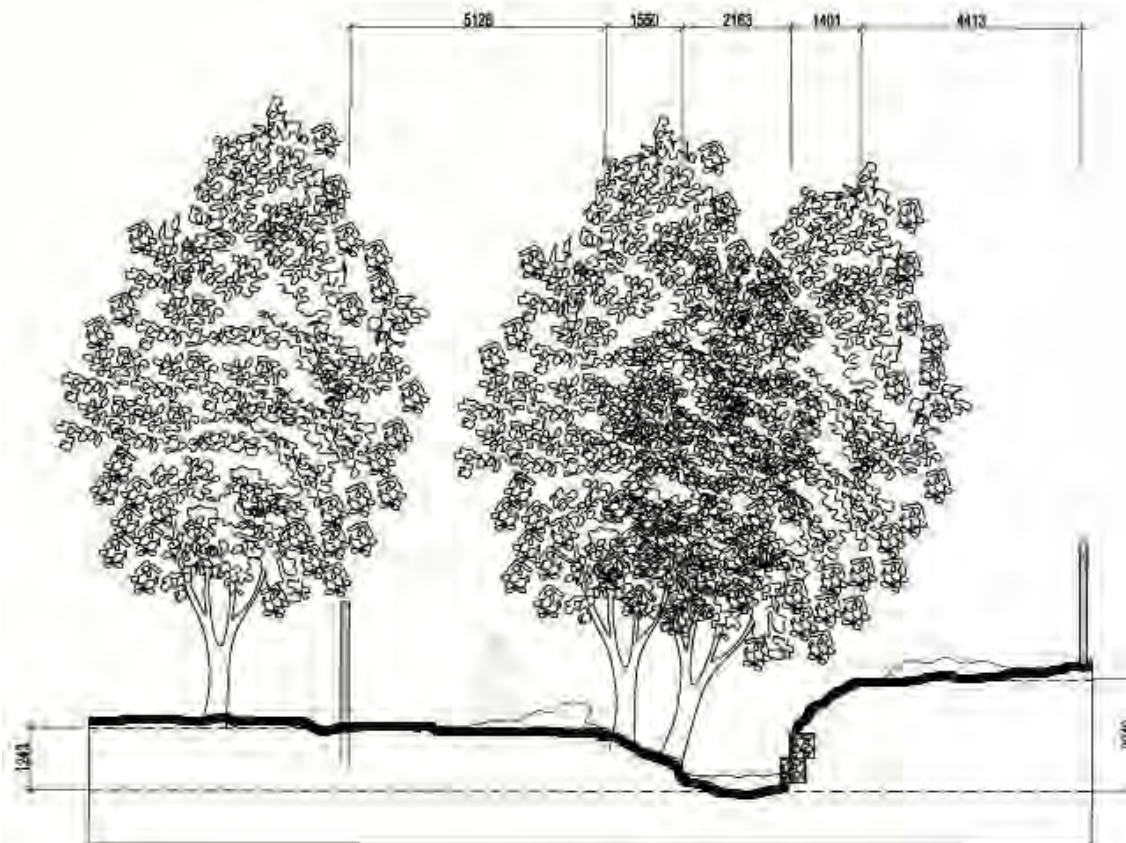
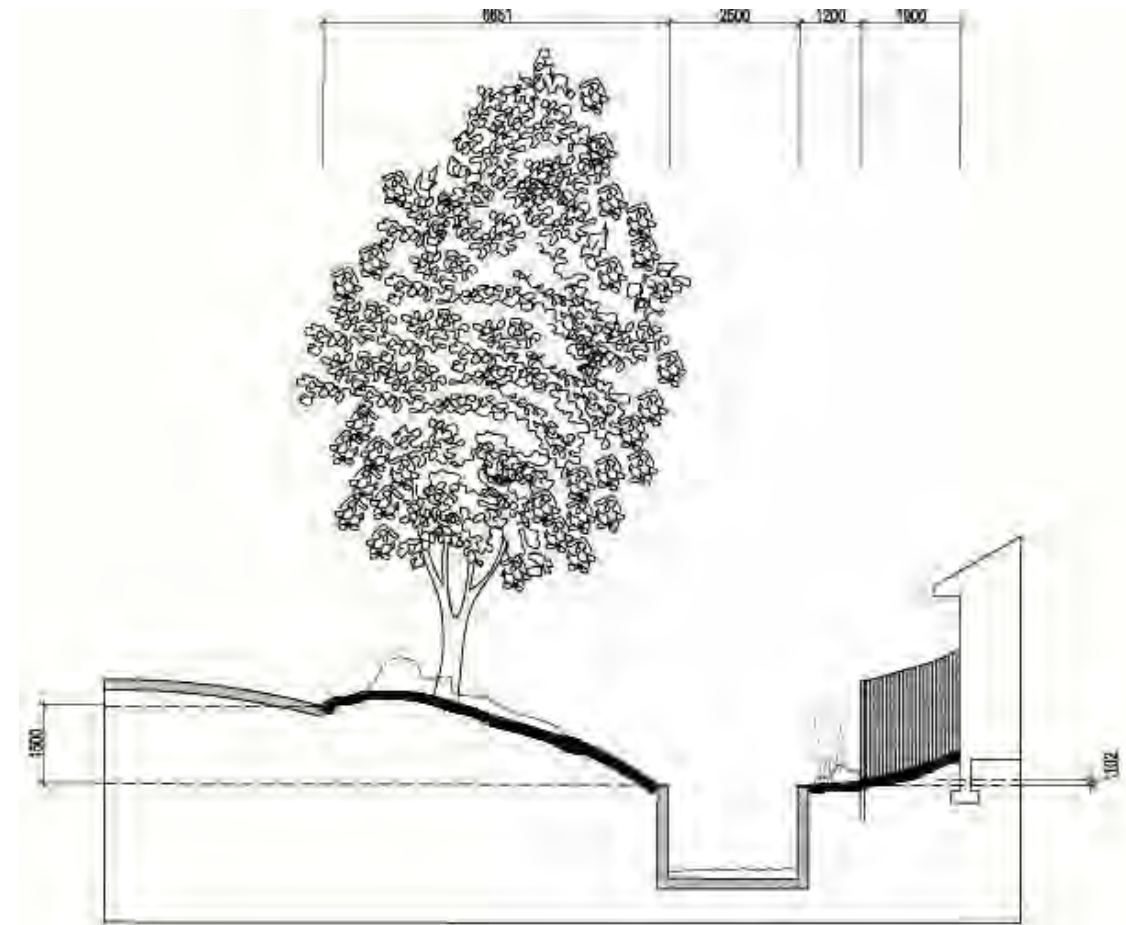
EXISTING SECTIONS



The section above shows a steep slope adjacent to the highway and a very tight space on the urban side of the Kromboom River. Barriers keep the urban edge closed off.



The section below shows the erosion problems experienced on the Kromboom River in its earth banks. The effort to gabion the bank seems to be working at least temporarily.

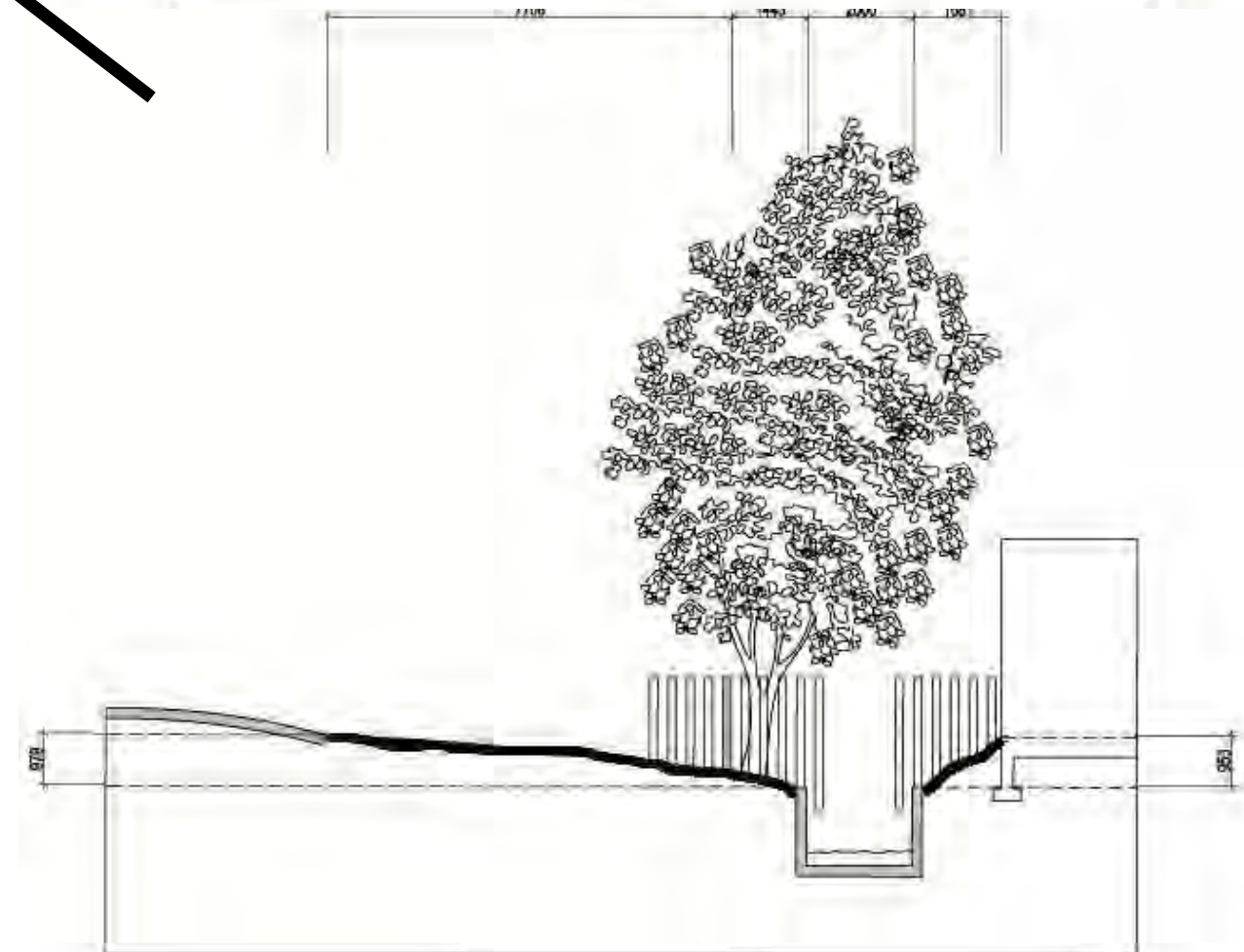
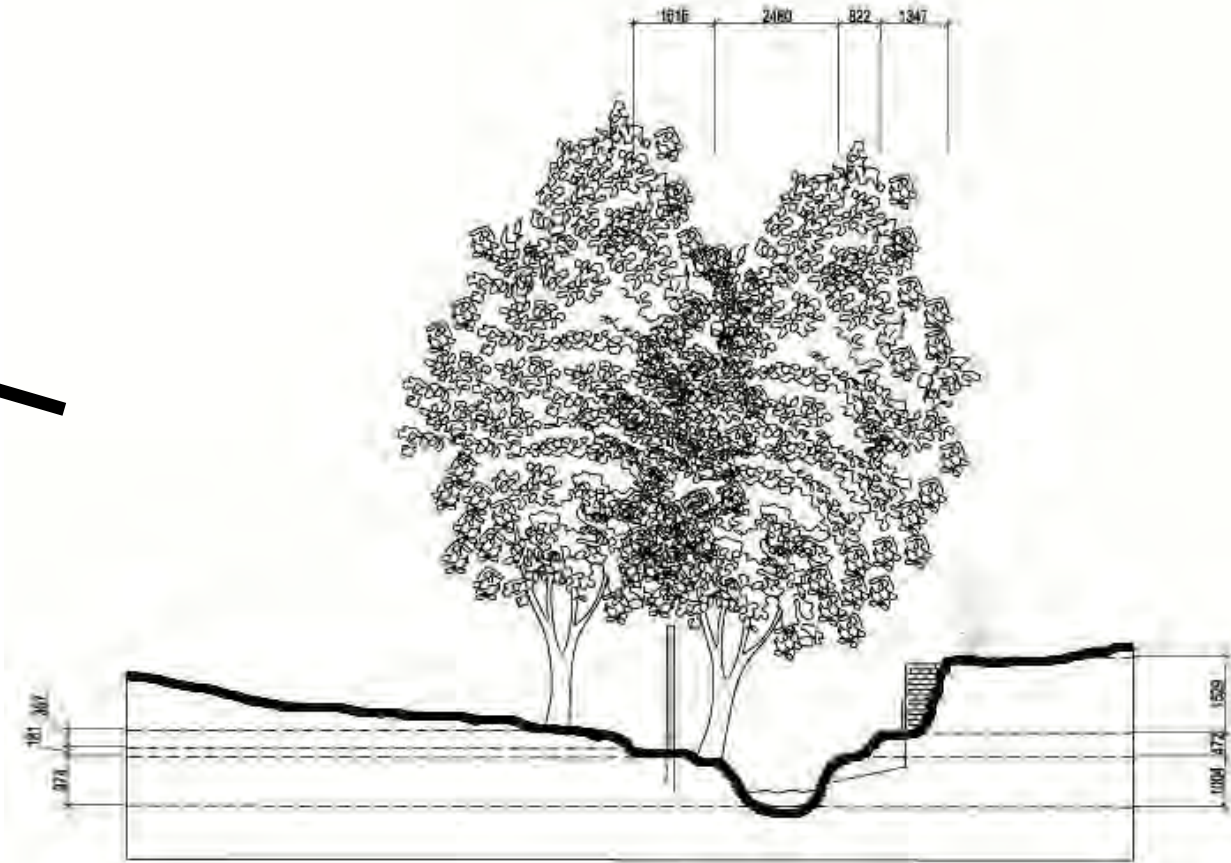


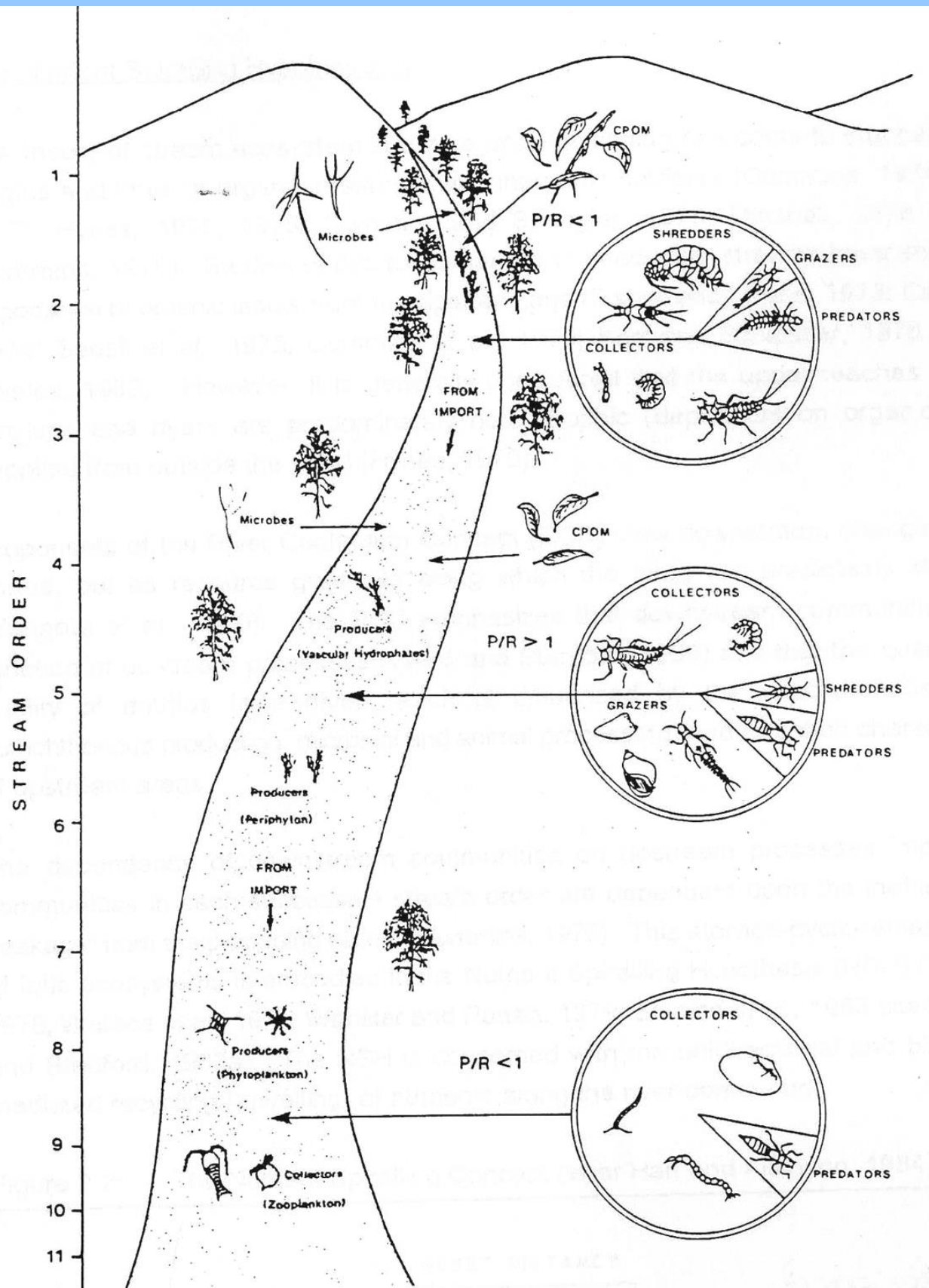
EXISTING SECTIONS



The section above shows a very steep slope up from the river to the top of the bank, and the rather unsightly stormwater outlet exposed on the embankment.

The section below shows the entrance of the Kromboom River into the site where it starts its journey in earth banks. The fence is unsightly and another barrier to contend with.





RIVER CONTINUUM CONCEPT

Environmentally Sensitive River Management, ENGEO Library, UCT, pg15

The South African Context:

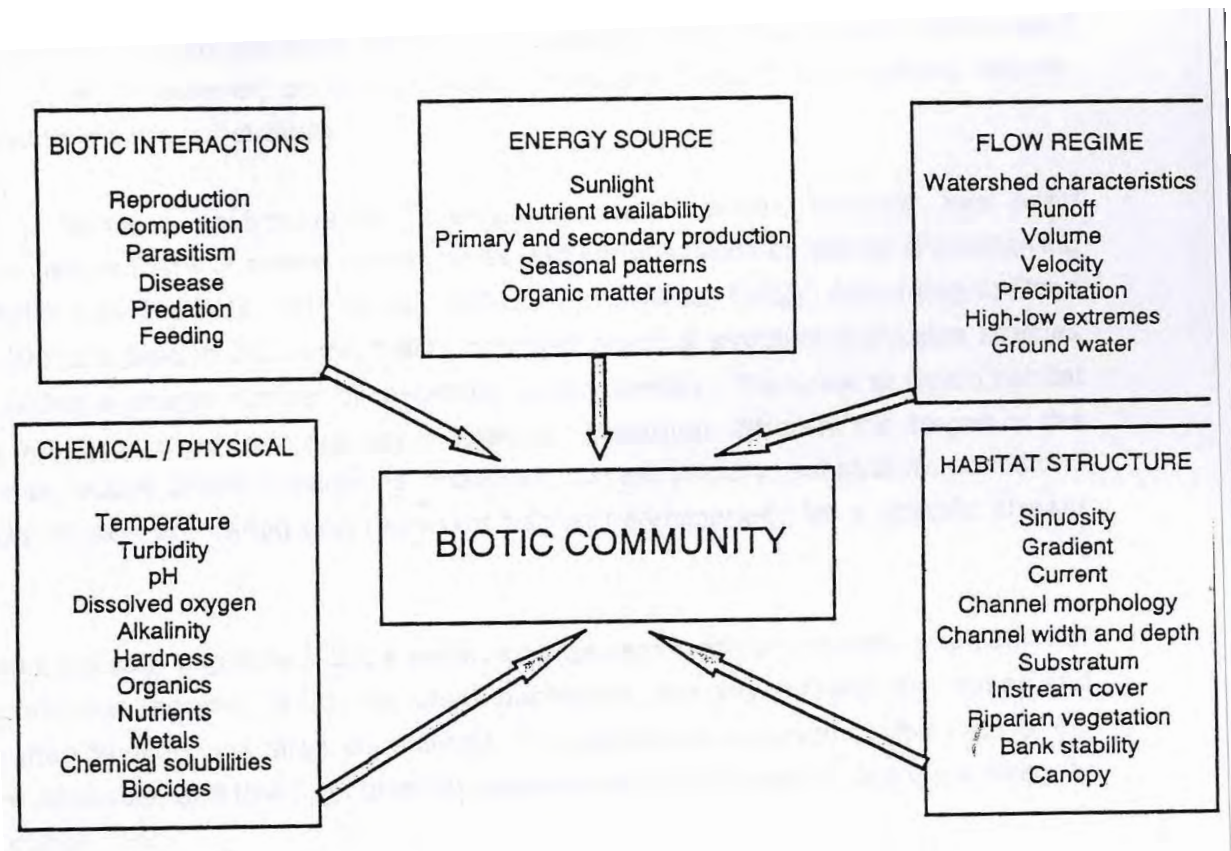
Rainfall in South Africa is not abundant over most of the country during much of the year. The prevailing south-easterly trade winds drop most of their rain along the south eastern coast, leaving the rest of the country in a rain shadow (Davies and Day, 1986;pg7).

The Lotic System: (flowing water system)

The southern and western regions receive only 17 % of the mean annual runoff of South Africa. A natural river starts as a clear stream cascading down a mountain widening and slowing as it moves through foothills and is joined by other tributaries. These natural rivers would contain complex networks of plants and animals adapted to survive in all its different reaches. These organisms would keep the water clean right down to the sea. Currently very few such rivers exist in South Africa. Human abuse has caused the natural communities of organisms to die out in these systems. The result is a dirty, sluggish drain, often flowing in a concrete bed, through a concrete landscape (Davies and Day, 1986;pg9).

The Natural River: Mountain stream

A natural river starts as a mountain stream, clear and free of silt. The water is oxygen rich and usually cold as most of the streams are in shade from the tree canopy. The water cannot leach many nutrients from the rocks and is therefore of "good quality". The powerful flow of water combined with the lack of nutrients does not allow for most organisms to live here. The water flows fastest in the middle of the river, and near the surface. The river edges and river bed slow the water down through friction. Animals which are streamlined can escape the force of the flowing water by pressing themselves against the substratum. These organisms feed on dead leaves, twigs and seeds which fall into the stream, as there is no plant life growing in the stream. The stones and boulders of the riverbed provide surfaces to cling and shelter as well as miniature dams where fallen leaves may become trapped. Without the unevenness of the stony bottom the basis of the food chain would be non-existent. This is why canalised, concrete streams are frequently devoid of living animals (Davies and Day, 1986;pg34-41).



Environmentally Sensitive River Management, ENGEO Library, UCT, pg26

The Natural River: Middle Reaches

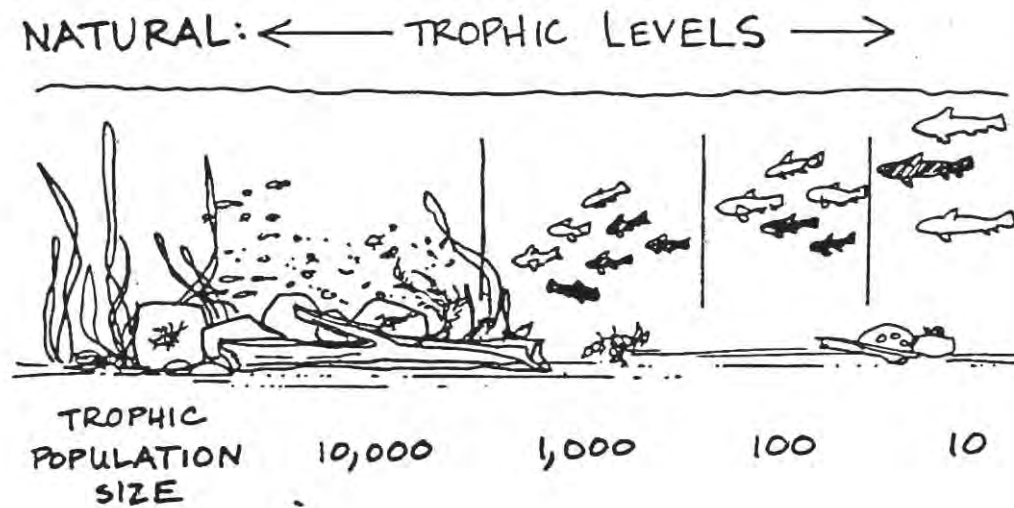
In the middle reaches the river bed widens while the water speed decreases due to the gentler slope. More sunlight reaches the water as the river becomes too wide for the tree canopy to completely cover it, which results in an increase in water temperature. Warmer water encourages the growth of small aquatic plants and some plankton. Vegetation can flourish where sediment is trapped between rocks. The water quality here is not as good. There is less oxygen available. The food-web here is based on the production of food in the form of green plants. The variety of organisms is greater, as well their potential to grow, because of this greater food source birds and fish abound here. The temperature differences occur seasonally and are due to local conditions (Davies and Day, 1986;pg41-44).

The Natural River: Lower River

As the river flows onto the coastal plain it continues to widen as it is joined by more tributaries causing the current to continue to decrease as the slope gradient decreases. The river starts to deposit sediment, covering the riverbed in a layer resembling a uniform sandy, silty blanket. The less turbulent flow and the micro-organisms breaking down the greater load of organic matter results in a much poorer oxygen level. The quality of water is much poorer due to the accumulated leaching of nutrients. The water is rich in nutrients so that water loving plants become abundant along the banks. The vast majority of the river is now exposed to sunlight and the water temperature is warmer encouraging the abundance of plankton which form the basis of the entire food chain. If the water is extremely rich in nutrients the plankton can reach "pea-soup" proportions. The main refuge of more usual aquatic forms is the semi-submerged riverbank vegetation. Partly submerged plants provide a surface for the growth of alga which is eaten. The very lowest reaches are abundant in bottom dwellers, a variety of birds which shelter in the reeds and bottom-feeding fish (Davies and Day, 1986;pg45-47).

The Natural River: Pollution

Common pollutants include industrial and domestic wastes (sewage, toxic metals, oils, washings, spillages, acids, alkalis, solvents etc.), litter, particulate waste, agricultural fertilisers, hot water and herbicides and pesticides. Pollutants enter the river from "point sources" which are specific entry points. "Diffuse" pollution occurs when pollutants enter the river, either from the atmosphere or from water draining the land in the catchments area.



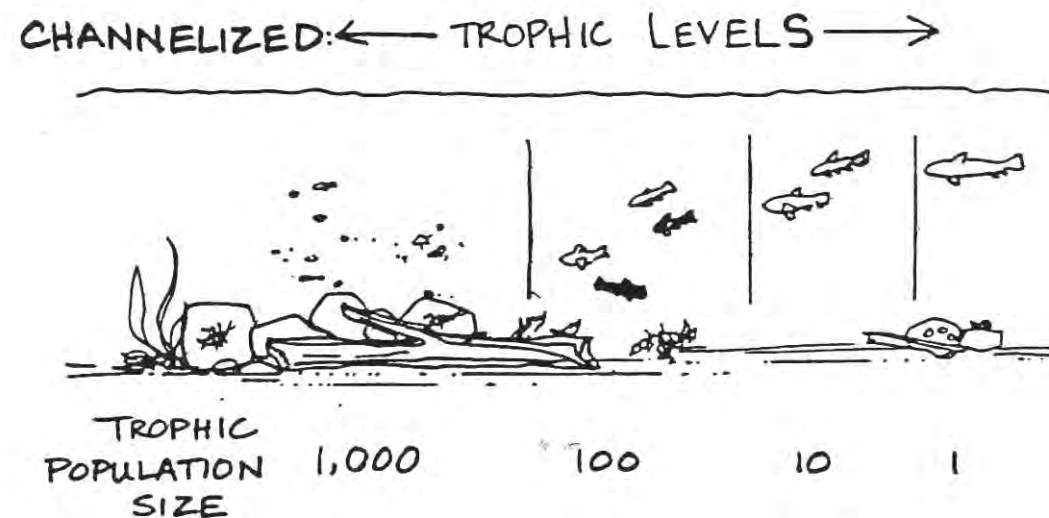
“Diffuse” pollutants are difficult to identify and control. The results of fertilizer getting into rivers is the pea-soup appearance of the water and the over abundance of aquatic plants clogging the river. Sewage is rich in organic matter and nutrients, but the effect of sewage on river water is a loss of oxygen due to the actions of micro-organisms of decay. Solid wastes like silt, can smother animals and their eggs. Litter in the form of plastic bags, tin cans etc is more unsightly, but can physically choke small streams. Thermal pollution increases the rates of biochemical reactions. Rates of biochemical reactions double for every 10°C rise in temperature, living at a faster rate uses more energy, using up more oxygen, placing already polluted systems under greater stress. Furthermore the life cycles of plants and animals will be altered (Davies and Day, 1986;pg51-58).

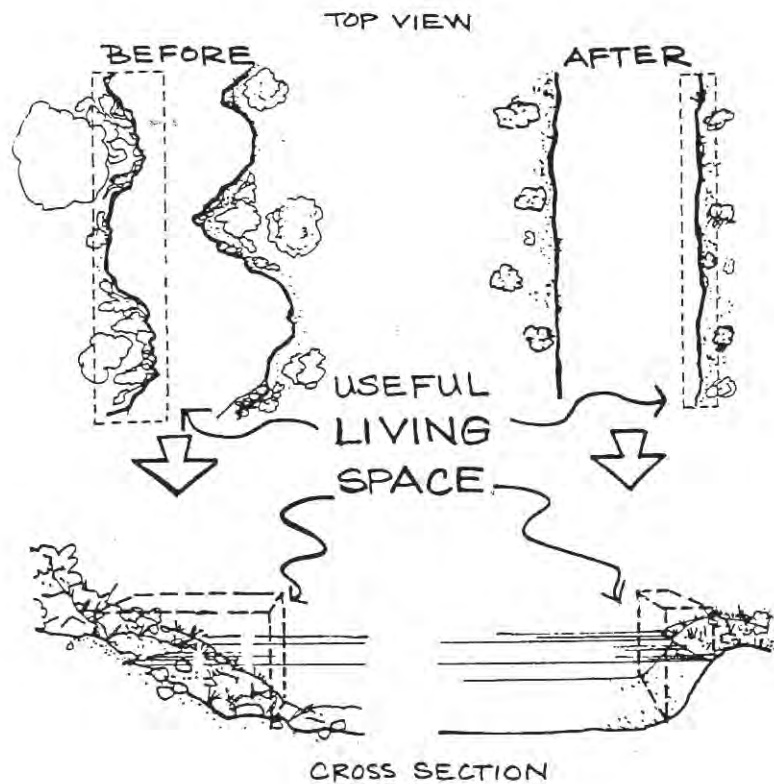
The Natural River: Self Cleansing Rivers and Organic Pollution

A large amount of organic material poured into a river usually kills all life at that point, but further downstream the signs of life reappear and even further downstream things return to normal as long as the river remains uncanalised. A river can clean itself of the organic loads we pour into it, due to the nature of moving water and the animal and plant life in it. The micro-organisms feed on the organic effluent at the course, and while they do use up oxygen in this area, they also produce many minerals nutrients. The mineral nutrients can be used by organisms further downstream while the oxygen levels also return to normal further downstream (Davies and Day, 1986;pg52-58).

The Natural River: Engineering

“Canalisation is the engineers way of stopping the rivers from cleansing themselves” (Davies/Day 1987). With smooth concrete as banks and bed, no organic material can be trapped and therefore few animals can live. Canalisation might have been invented to prevent flooding of low lying areas, but with proper legislation, these lands would not have been developed in the first place. Though it is now recognised that building development should not occur below the fifty-year flood line, preventative legislation is rarely enforced. Pay attention to the plants growing in the prospective area. If they are riverine plants, do not build there. Reducing vegetation cover around a river may increase the speed of water runoff into the river, causing it to flood. The increased speed of water runoff also decreases the amount which is absorbed into the ground, which could result in the river drying up in summer. Loss of plant life may cause topsoil to be washed away, and may cause river banks to collapse, contributing to erosion, the Disa River in Hout Bay is an example of this (Davies and Day, 1986;pg58-60).





Environmentally Sensitive River Management, ENGEO Library, UCT, pg45

Modifying Natural Rivers Through Channelisation and Canalisation:

Rivers flowing through urban areas are usually confined to trapezoidal earth channels, 'straight-jacketed' in concrete or buried in underground conduits. The urban rivers bear the brunt of increased flood flows and pollution which are the results of urbanisation. The result is a severely degraded riverine ecosystem. The potential for recreation, relaxation, water-purification, micro-climate enhancement, nature conservation and flood mitigation is restricted. Rivers are engineered to dispose of stormwater runoff and function as drains. Channelisation involves increasing the width and/or depth of the channel, as well as straightening the alignment. This increases the discharge of natural river channels by increasing the cross-sectional area and reducing the roughness of the channel. Straightening increases the slope and therefore the flow velocity. Canalising involves concrete-lining the bed and banks of the river (Davies and Day, 1986;pg59-60); (Davies and Luger, 1994); (Dunne and Leopold, 1978).

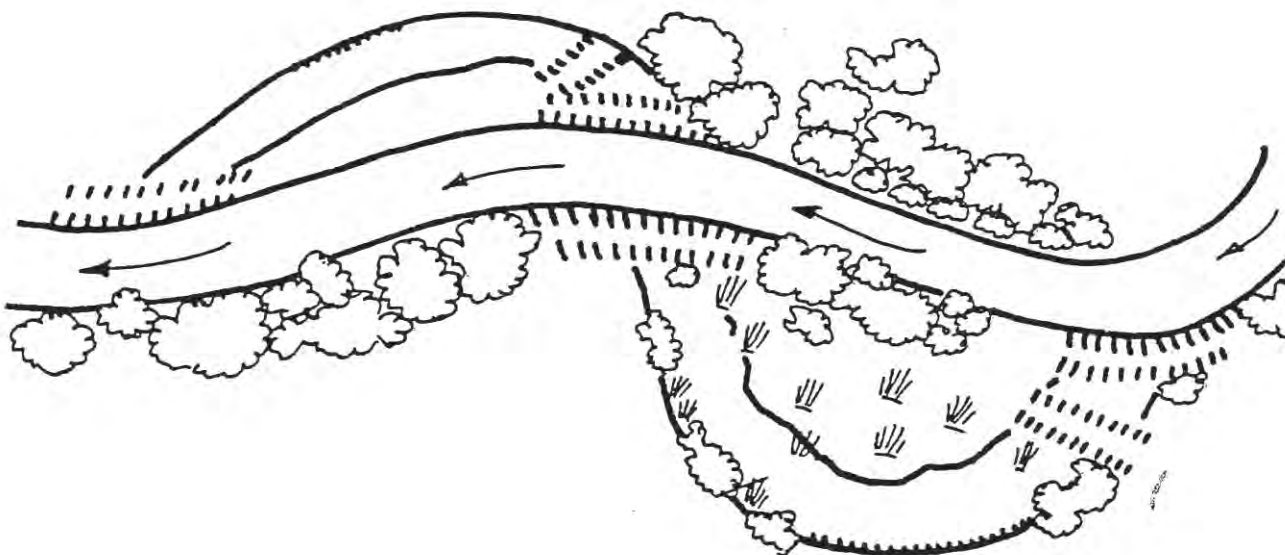
Results of Channelisation and Canalisation:

Aesthetic degradation of the river and corridor. Impairment of recreational and educational opportunities. Reduced biological filtering of the water. Reduction in the conservation value of both the river and corridor and the impairment of linkages between fragmented natural habitats. An increase in stormwater efficiency (Davies and Day, 1986;pg59-60). (Davies and Luger, 1994).(Dunn and Leopold, 1978).

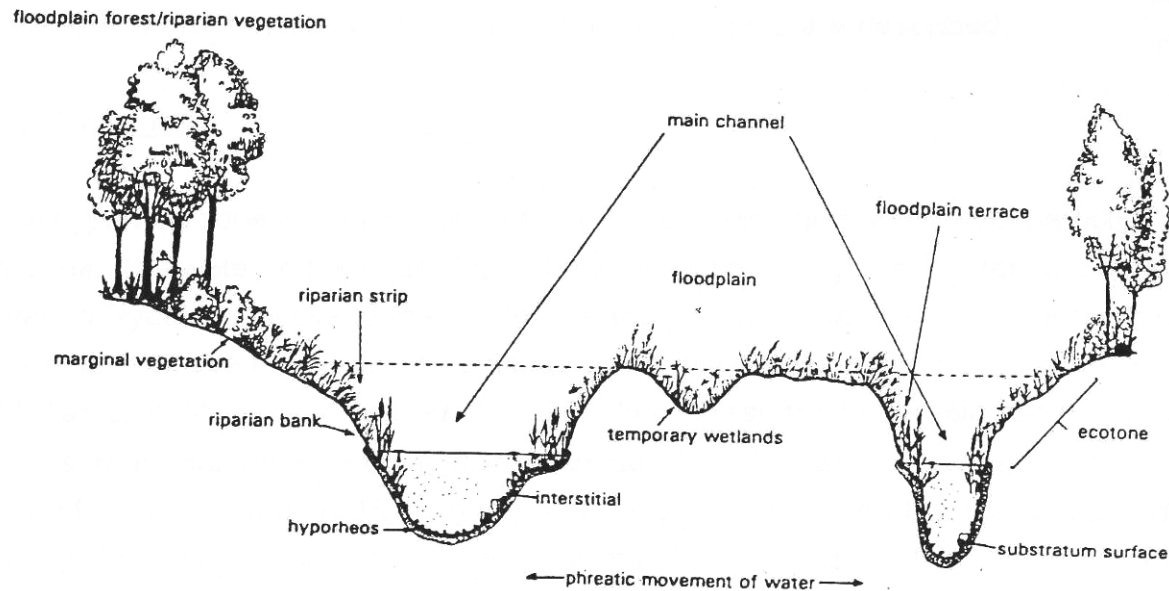
Environmentally Sensitive River Management:

"A prudent technology should alter the natural order as little as possible"
(Leopold, 1941 cited in Likens and Bormann, 1974, p 454).

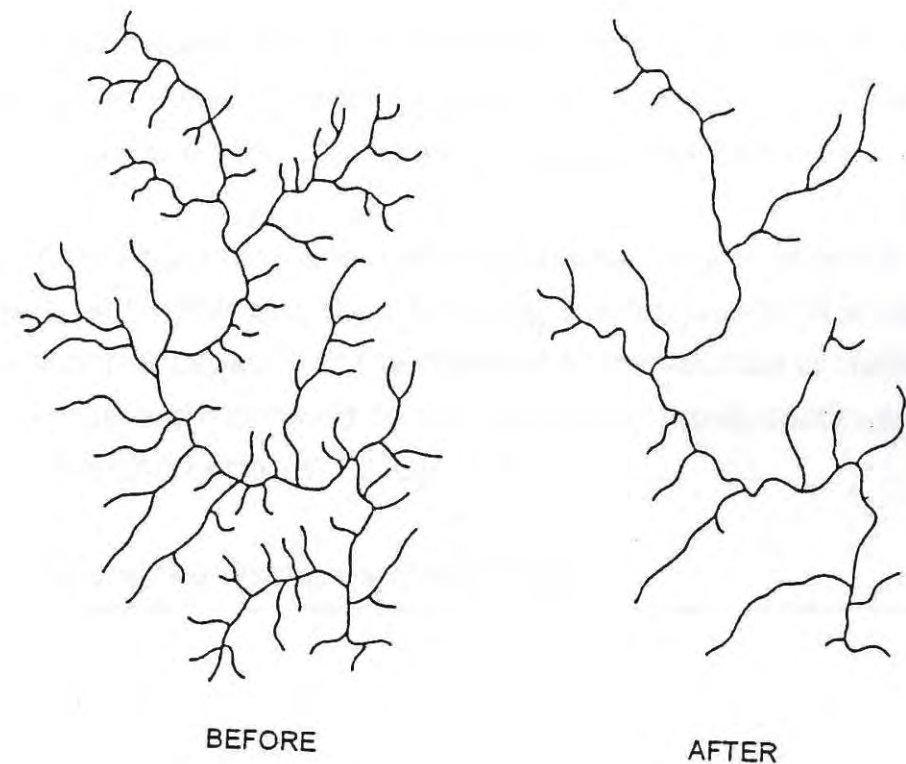
The emerging philosophy on dealing with urban flood management involves a mixture of structural and non-structural approaches. Non-structural approaches include catchments management (on-site storm water retention) and flood plain management (land use zoning). Structural approaches relate to river channel works, such as retaining meanders and riverine vegetation. Environmentally Sensitive River Management,1994;67).



Environmentally Sensitive River Management, ENGEO Library, UCT, pg114



Environmentally Sensitive River Management, ENGEO Library, UCT, pg19



Environmentally Sensitive River Management, ENGEO Library, UCT, pg30

Catchment Management Objectives:

Limit the increase in stormwater runoff as much as possible. The quality of water discharged or seeping into receiving stream systems should not be detrimental to aquatic organisms (Environmentally Sensitive River Management, 1994;73).

Floodplain Management Objectives:

Ensure that lower order streams are not infilled or lost and that urban development does not occur within the floodplain of the main rivers. The floodplain to be reserved or developed for amenity and conservation purposes (Environmentally Sensitive River Management, 1994;73).

River Channel Management Objectives:

Maximise the physical diversity of the channel in order to maximise the biodiversity and conservation value of the river (Environmentally Sensitive River Management, 1994;73).

“In the past ‘improving’ rivers often meant increasing the flow capacity. In future it should refer to multi-purpose schemes designed to improve the capacity of each river valley to function as a visual amenity, a recreation area, a fishery, a nature reserve, a water supply, a storm detention area, a drainage network and a movement corridor ” (Tom Turner, Landscape Planning, 1987 cited in Gardiner, 1992).

Non-Structural measures Treat the Cause:

Environmentally-sensitive catchment management aims to reduce the volume of stormwater runoff with the following resultant advantages: A reduction in downstream flooding, reducing the need for downstream channel upgrading, protection of the riverine ecosystem and improving the quality of stormwater runoff.

Reducing Stormwater Runoff:

The storage of rain on flat topped roofs or in car parks, using stone filled trenches, porous pavement and grass lined channels and detention dams (Environmentally Sensitive River Management, 1994;77).

Water Pollution:

Educating people in the catchment area about the use of fertilisers, pesticides and toxic substances and the effects these will have on the water systems, encourages a more sustainable rehabilitation in the area. Rehabilitation can be brought about in a number of ways for example through the use of wells, ponds, trenches, vegetated channels and wetlands, and the diversion of the 'first flush' (the first runoff from a rainfall event) to a waste water treatment works. The concept of removing the minimum amount of stormwater required for the safety and hygiene of the urban area, at the slowest possible rate, would result in reduced peak discharge, increased infiltration, reduced pollution, and less degradation of receiving waters. The impact on aquatic organisms would be reduced helping to generate the natural rehabilitation of the water system.

Maximise Physical Diversity:

Physical diversity must be preserved where it exists, or newly created where it is no longer found.

"The basis of habitat conservation is the assumption that species richness follows from habitat richness, subject to limits imposed by chemical water quality, and that biological diversity is the prime conservation objective" (Harper et al., 1992, p318).

Work with Natural River System:

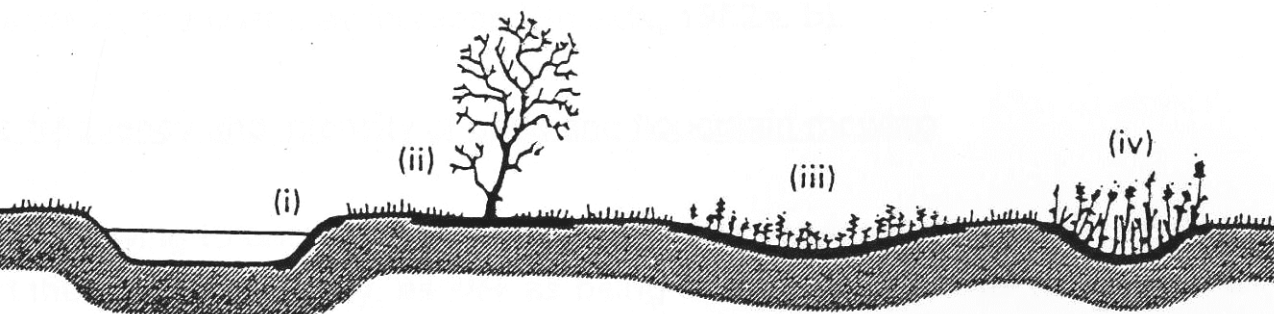
The biological recovery of rivers depends on their morphological recovery, natural river features, such as pools and riffles, must become established before recovery of the aquatic community, or natural biological and animal inhabitants, can occur (Simpson et al., 1982; Swales, 1982). These features must make use of flow dynamics, that is, work with nature, to be self-maintaining.

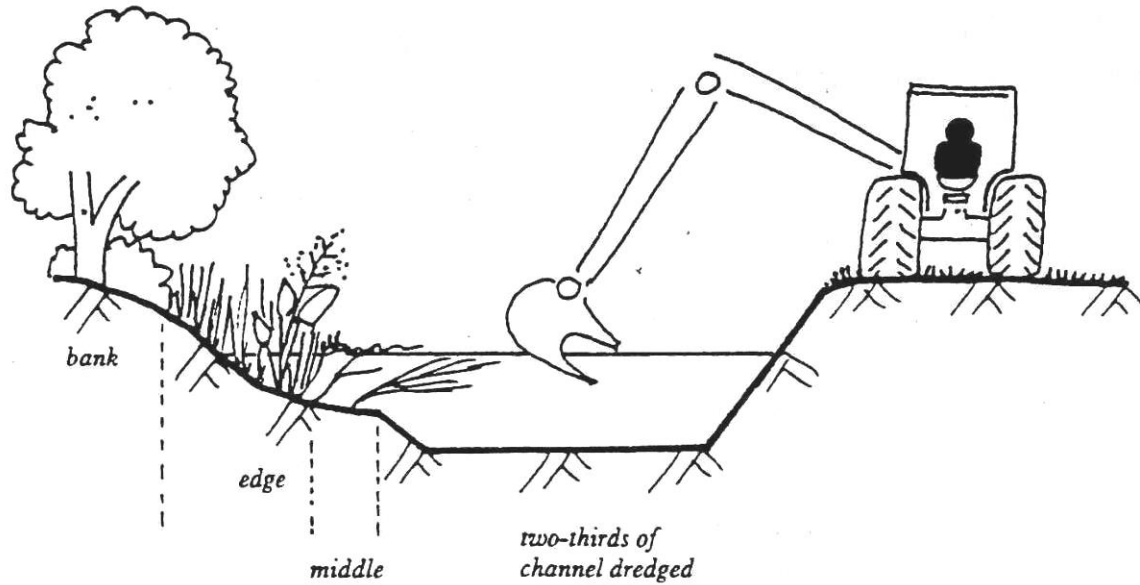
Site Specific Designs:

Environmental objectives are best attained when channel design is accomplished through attention paid to the specific details of the site (Shields, 1982a).

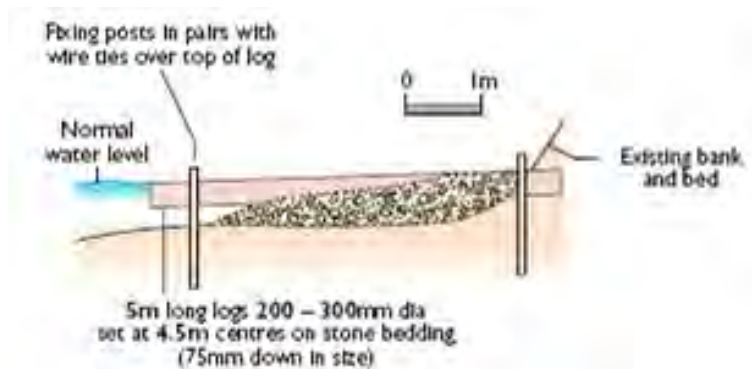
River Maintenance:

All river maintenance offsets recovery. While a lack of it permits gradual recovery, regular maintenance will encourage "weedy" species at the expense of more permanent shrub vegetation.





Environmentally Sensitive River Management, ENGEO Library, UCT, pg95



Disposing of Spoil Material:

Excavated material should not be placed on river banks, dumped on marginal habitats, spread around trees or used to fill in hollows in the floodplain. It is aesthetically unpleasant and the nutrients leach back into the river. Use excavated material to construct visual and noise barriers.

Modifying One Bank:

The most valuable areas for wildlife or aesthetics should be maintained by alternating between sides (Shields, 1982b; Brookes, 1988).

Shading of Aquatic Weeds:

Planting clumps of trees on alternating sides of the river, far enough up the bank to prevent root erosion. Will shade the river helping to prevent the growth of weeds but also allow for bars of sunlight to penetrate.

Sediment Traps:

Trapping sediment has positive effects on downstream aesthetics, recreation, water quality and aquatic habitat (Genetti, 1989). Shorter traps can be about 10m in length and one metre deeper and two metres wider than the rest of the river channel (Iversen *et al*).

Bank Protection::

Dykes, jetties or gabions, projecting perpendicular or slightly downstream will create protected slack water habitat on the downstream sides of the structure and this will encourage deposition of stable substrate (Genetti, 1989). Traditional methods of river management frequently uses the attributes of local plants to stabilise banks and deflect flows. Vegetation is more resilient, and will not cause degradation of the environment when it erodes or falls apart. Grassed channels have the benefits of low velocity and low construction costs. Sod-forming grasses should adequately protect the banks of low-gradient streams (Beschta and Platts, 1986). The interlocking concrete block systems available are Terraforce, Terrafix, Loffelstein, Waterloffel and Armorflex, which are all flexible and can be used to stabilise gentle horizontal and vertical curves. Where used for bank stabilising, they usually require a gabion or reno matress foundation and/or concrete grouting on the lowest layer.

“To induce the urbanite to leave his home with its battery of entertainment machines, the new walking street must needs offer – well – entertainment” (Bernard Rudofsky, 1977; pg6).

Environmental Improvements:

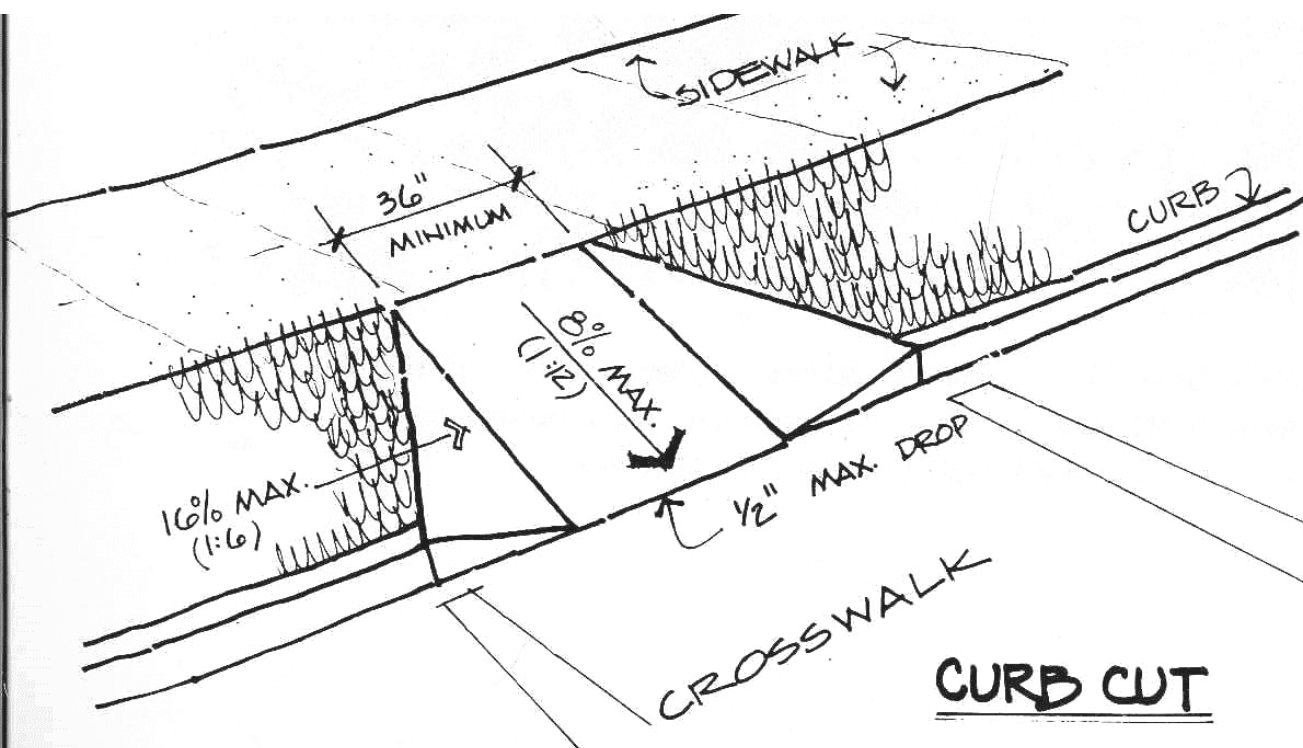
Two factors affect urban air quality; street level pollution and upper level pollution. Street level pollution is highly concentrated, but local, and not easily dispelled. The most effective way to clean the air is to limit traffic. Octave-band analysis shows that traffic control gets rid of a large percentage of high frequency sound, leaving only those low-frequency noises which originate in the surrounding area. High-intensity, high level lighting is light pollution (Brambilla, 1977; pg22-23).

Physical Image:

Repaving streets to sidewalk level has the effect of eliminating the inhibitions established by a separation of road, curb and sidewalk, while adding a sense of formal unity to the entire street. Pedestrian-orientated lighting helps to restore a more intimate and natural scale to streets. Linear parks set into an existing right-of-way are elements in the design of traffic free zones. (Brambilla, 1977; pg22-23)

Social Benefits:

As density increases, allocation of open space decreases to the point where pedestrians are squeezed into the leftover spaces between traffic and buildings. “High-quality spaces”, are the ones which give the greatest range to pedestrian activities.; an environment free from the constraints imposed by traffic can begin to offer unhampered movement, social amenities, and comfort to pedestrians. People favour flexible environments, while they dislike static design elements that clutter and interrupt or channel their movements. Providing socially responsive areas is an important service to an urban population, particularly to those people rarely considered by planners – children, people with infants, the elderly and the handicapped (Brambilla, 1977; pg25-27).



Unterman, 1984, pg47

Pedestrian safety:

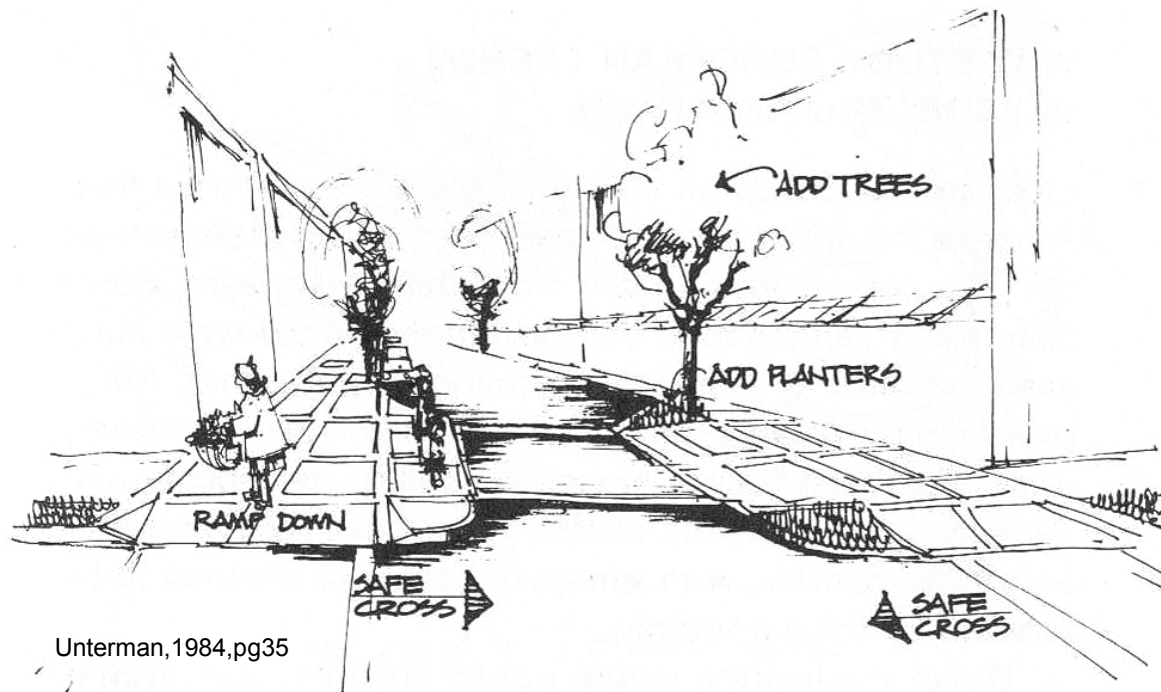
Banning traffic has increased pedestrian safety. Pedestrian deaths caused by automobiles represent 20 – 30 % in Europe and the United States. Crowds of people help to create an atmosphere of security which in itself discourages crime (Brambilla, 1977;pg27). Using Safe cross pavements allows pedestrians a better view of traffic, reduces the street crossing width, and slows traffic. (Untermann, 1984;pg35). Safe crosses can be 4-7 feet wide and 20-25 feet long.

Community Participation:

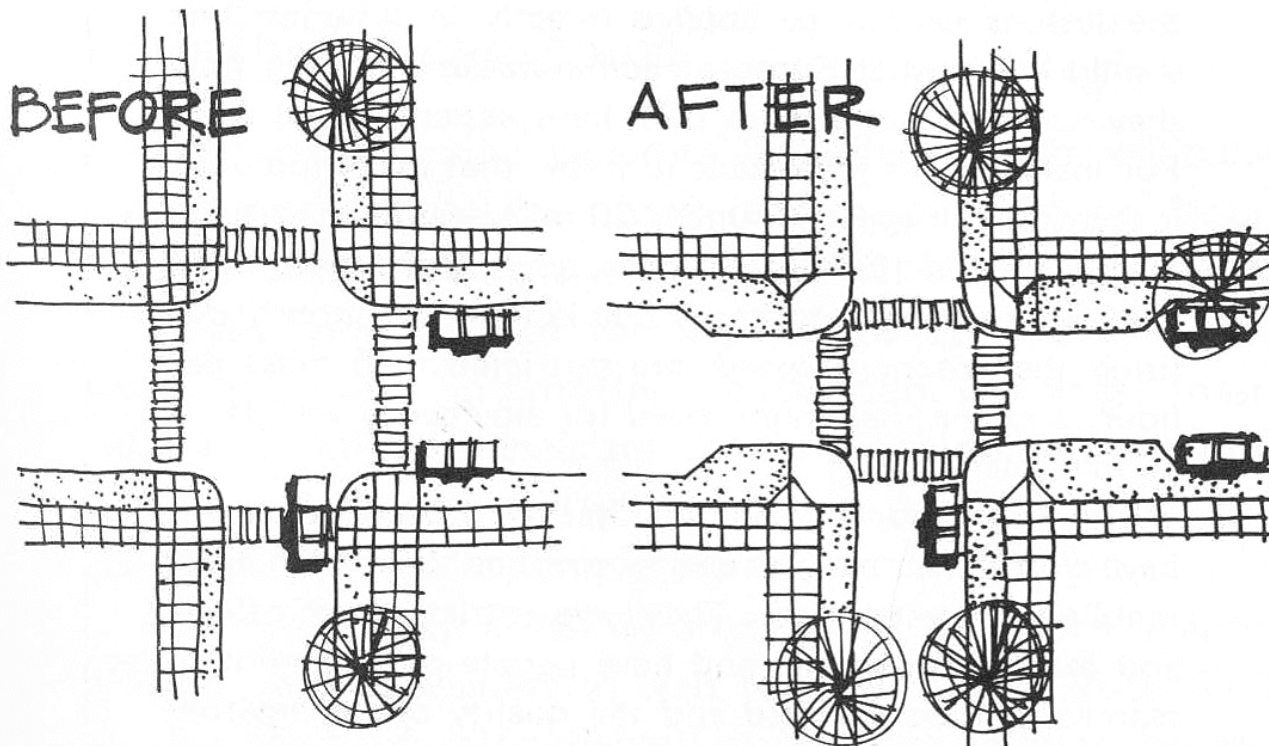
In most successful examples, the public has been involved in the process from the very outset (Brambilla, 1977;pg30, City Engineers Department, 1982;pg17 ,CMOSS, 2007;pg14).

Qualitative Aspects of Design:

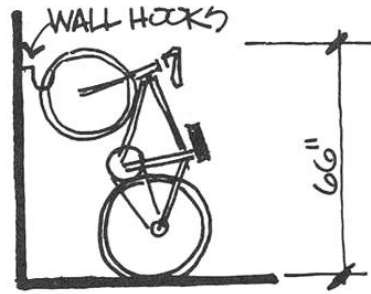
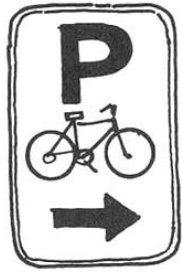
Observations of pedestrian areas indicate that it is not the weather, the shops, the urban spaces or architecture that is the focus of people's attention, but rather other human beings. Although good design features are important components of a high-quality public space, the main consideration should be the generation of high levels of activity. Pedestrian activities can be grouped into six primary actions: walking, standing, sitting, lying, running and playing. Physical limitations have a strong impact on where to walk. Direct routes and shortcuts are preferred, while steps, slopes and long stretches are usually avoided. Providing adequate seating is essential to the creation of a high-quality space. Seating in hot climates needs to be placed in cooler, shaded locations. A view, or scenery is perhaps the most important factor affecting the use of seating. If a bench is not facing anything, it will either remain empty or be used only in case of necessity. Plants muffle noise, absorb gases, and retain dust and particles. They also reduce glare, provide shade, insulation and can be a wind shield. Signs not only contribute information and vitality to the urban environment, but if well designed, also improve the character and flavour of the area. There are two basic approaches to street furnishings; they can be distributed throughout the entire space to enhance the overall interest of the area, or concentrated into multi-purpose groups. Pedestrians are best served by low light sources and varied intensities of light. Changes in light intensity create a more stimulating environment. If light poles are spaced regularly and fairly close together along a pedestrian way they help create visual rhythms with other elements of the street (Brambilla, 1977;pg48-56).



Unterman, 1984, pg35



Unterman, 1984, pg35



Design Features:

A series of recurring elements convey a sense of cohesion and modernity. Uniformly placed and sized light fixtures give a sense of scale (Torg – Stockholm). Street signs should be modest and tasteful, it is up to the pedestrians to provide colour and liveliness. (Stroget – Copenhagen). Hiding the lighting within a stand of trees creates the impression that there are no lights during the day (Brambilla, 1977;pg65).

Transportation:

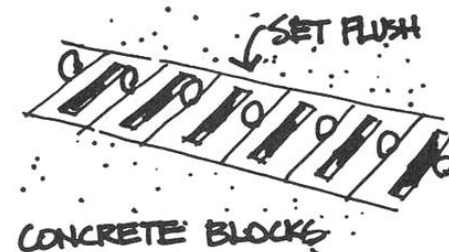
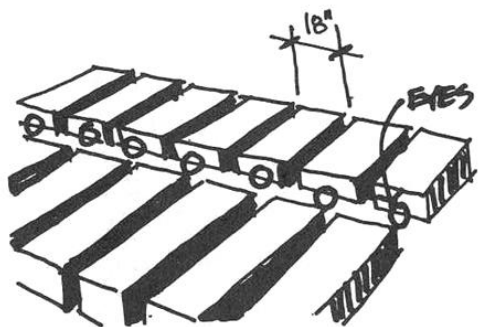
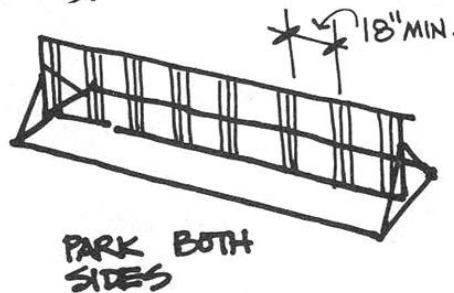
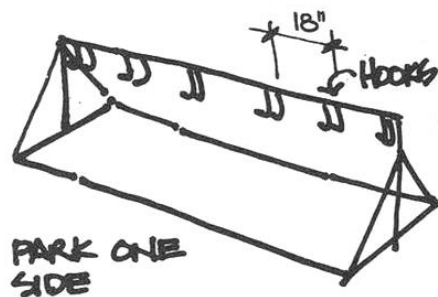
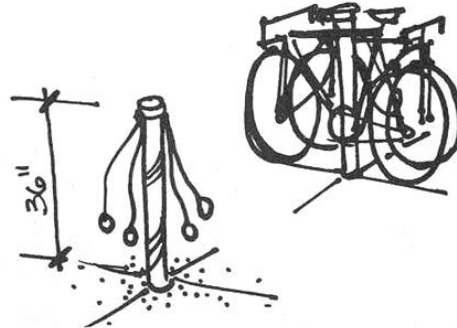
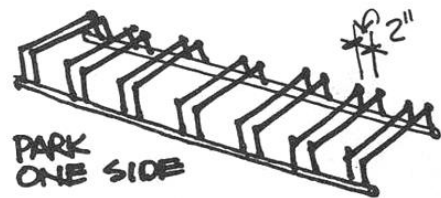
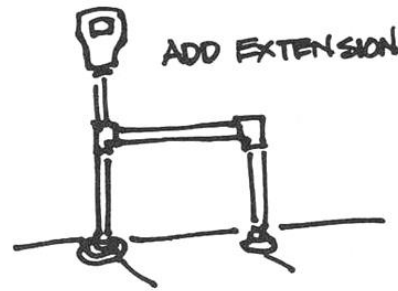
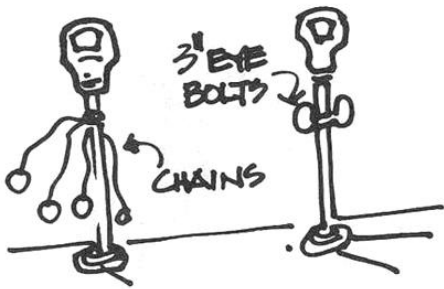
“Pedestrians need safe, comfortable and accessible routes covering the entire city” (Untermann,1984;pg4). *“A good transportation system minimizes unnecessary transportation”* (Untermann, 1984;pg4).

A Good Pedestrian Environment:

Reducing travel distances, increasing land-use flexibility and eliminating pedestrian barriers. Levelling walking routes and also assuring continuity of travel, as well as providing some form of weather protection all promotes a good pedestrian environment. Also eliminating conflict and increasing character (Untermann,1984;pg6). Auto access drop-offs and concentrated parking that comes within a reasonable distance of final destinations, with walkways leading from parking places to destination points (Untermann,1984;pg7). Planning emphasis should be put on efforts to assure continuous accessibility and safety to handicapped persons (Untermann,1984;pg7).

Bicyclists:

An adequate number of bicycle racks near an entry may prevent vandalism or theft and bring the riders close so they can choose to walk from there (Untermann,1984;pg14). Develop fine grained networks (Untermann,1984;pg14). Pedestrian and bicycle routes should be planned for maximum use, protection, safety, variety and amenity (Untermann,1984;pg14). Pedestrians and bicyclists should be able to meander, rest, warm up in the sun, stop, visit, or seek protection from the rain (Untermann,1984;pg15). The human eye visually encompasses about three objects every second. Fewer than three can induce boredom, while more can create confusion. Thus pedestrians benefit from increased visual complexity (Untermann,1984;pg16).



Unterman, 1984, pg92

Pedestrian Scale:

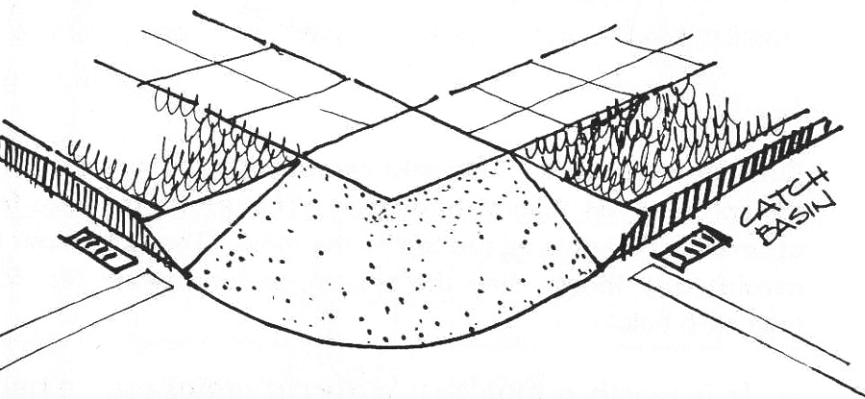
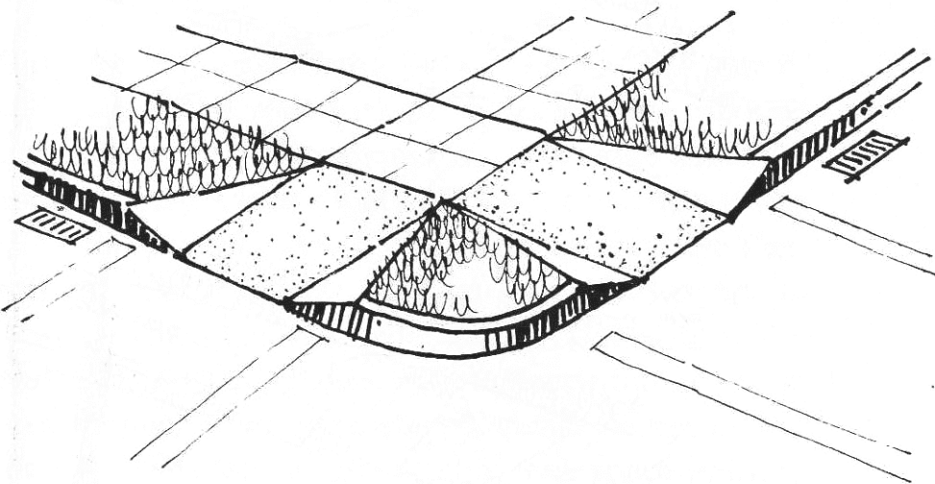
It is important that each object be approximately the size of the human body, is close at hand, is constructed of small pieces, and is diverse (Untermann,1984;pg17).

Walking Experience:

A walk with few barriers contributes to psychological well-being and walking pleasure (Untermann,1984;pg43). Providing some protection from bad weather extends the walk potential. Pedestrian furniture enhances the visual experience and reduces the apparent walk length (Untermann,1984;pg23-30). If there is little break in a repetitive pattern, the walk may seem longer and progress may seem slow. Ramps impede foot traffic less than stairs, as more people are able to use them without difficulty (Untermann,1984;pg43-44).

Waiting:

People wait to watch other people – the greatest spectator sport. Waiting can be made more comfortable with weather protection, seating and space. Waiting is more comfortable if it is slightly out of the line of traffic. Intersections are good locations for benches. Any height from between 12 and 24 inches will work with 16 inches being the best. A width of between 6 and 24 inches works fine. Benches should be arranged so that groups of people can use them while talking. Moveable seating should also be considered.



Unterman,1984,pg47

Ways of countering disabilities do not alter if consideration is given to disabled people, they simply become more significant. What may have been a bonus, becomes a prerequisite; non-slip floors, low level shelves, railings etc. (Goldsmith,pg21).

Movement and Access:

Ramps:

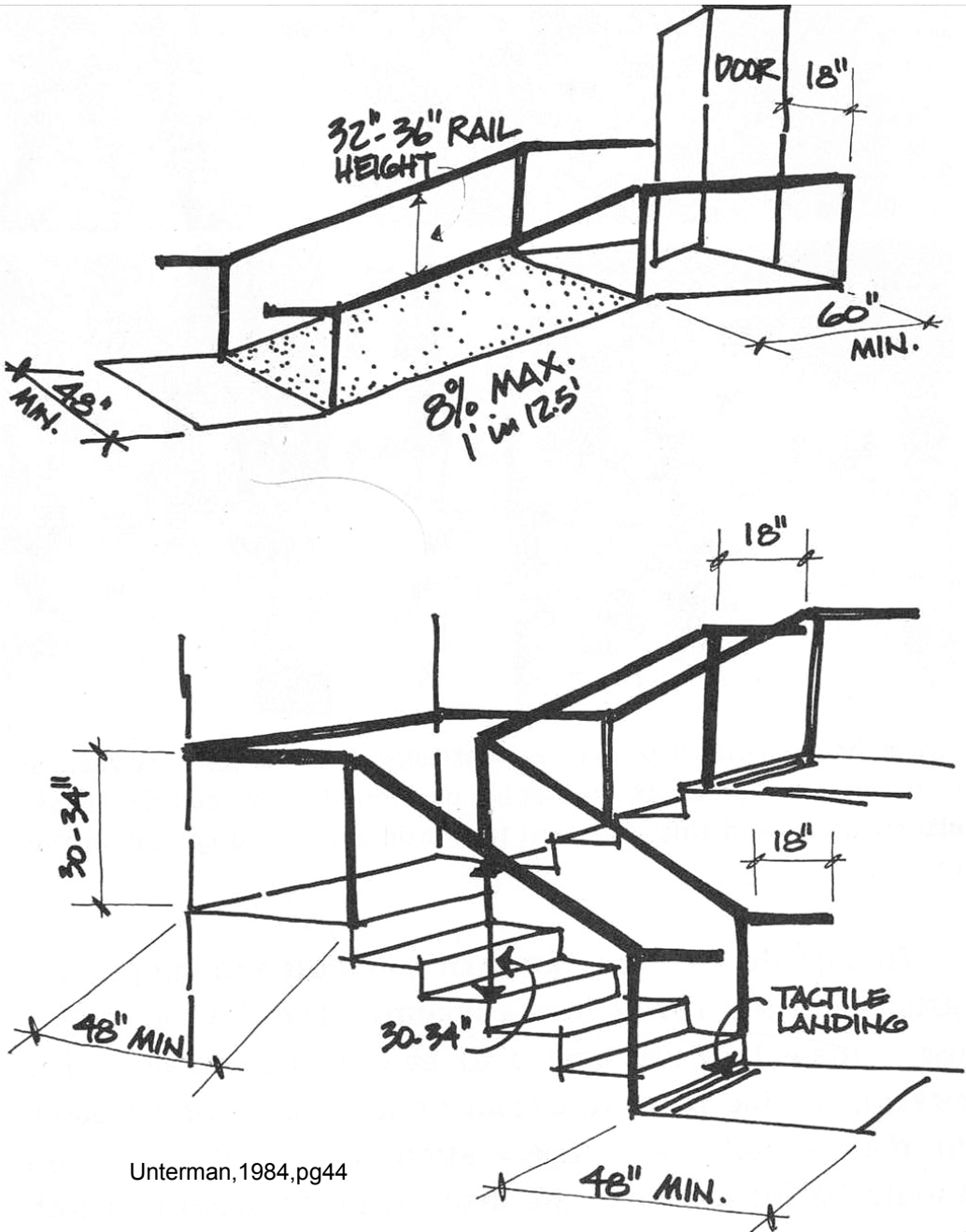
Ramps should be designed at a maximum 8 percent slope (1/12), with 5 percent(1/20) being preferred. Ramps should have rest spots at every 1 metre height change. Railings should always be considered for ramps. Designers should think of the ramp as the main route, and the stairs as the by-pass route. Wheelchairs require about a six-foot radius for turning. Ramps must be a minimum of 36 inches wide and should have continuous handrails. The surface of ramps should be roughened for grip, but not with bumps. Asphalt and concrete are ideal surfaces. A wheelchair cannot stay stable with a cross slope of 2 percent or more. Handrails can be avoided in some places by extending the level area with a retaining wall or planting. Curb cut ramps should be used wherever possible. Ramps can be made non-slip with the application of a surface dressing of hard wearing chippings. Where a non-abrasive material is required surfacing may be of cork granules (Goldsmith,1984;pg168-171).

Bollards:

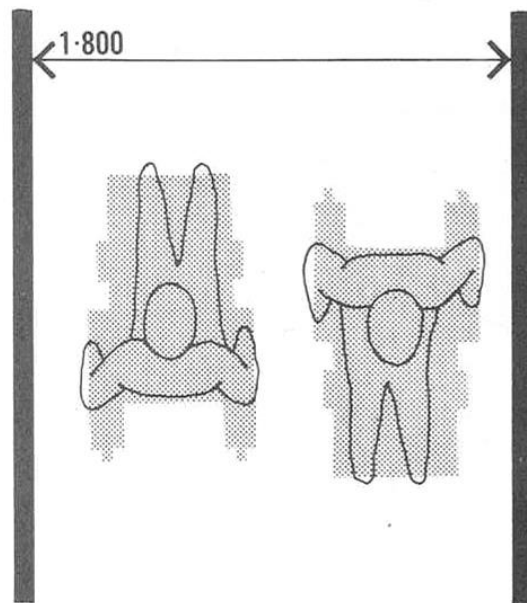
The minimum width between bollard bases should be 0.900m (Goldsmith,1984;pg164).

Walkways:

Raised crosswalks are sections of road which have been raised to meet the sidewalk level. The ramps on either side enable cars to cross, but also enable wheelchairs to get onto or off of the sidewalk easily. The crosswalk should be made of different materials to the road to indicate to traffic that it is a pedestrian space, e.g. cobbles. A walkway intended for wheelchair users to pass each other should be 2.000m wide. For independent wheelchair users the gradient should not exceed 1:20 (5 per cent) (Goldsmith,1984;pg163-164).



Unterman,1984,pg44



Goldsmith, 1984, pg149

Rails:

At least one rail should be provided when a ramp is stepped. Where there is a drop on any side of the ramp a rail must be provided. Handrails should be positioned at least 1.000m above ramp level. Where ramps end, the handrails should extend for at least 0.300m beyond the landing point. A handrail should be easy to grip. A circular section of 0.050m is fine (Goldsmith, 1984; pg173-175).

Circulation:

Passing space needed for two self propelled wheelchairs – 1.800m

Space for a wheelchair turn through 90 ° – 1.400 x 1.400m

Space for a wheelchair turn through 180° – 1.400 x 1.800m

An unobstructed space for wheelchair stationary turn – radius 0.850m circle

The wider an opening, the less space needed for a wheelchair maneuvering to pass through to pass through.

A space for persons on crutches to pass – 1.900m

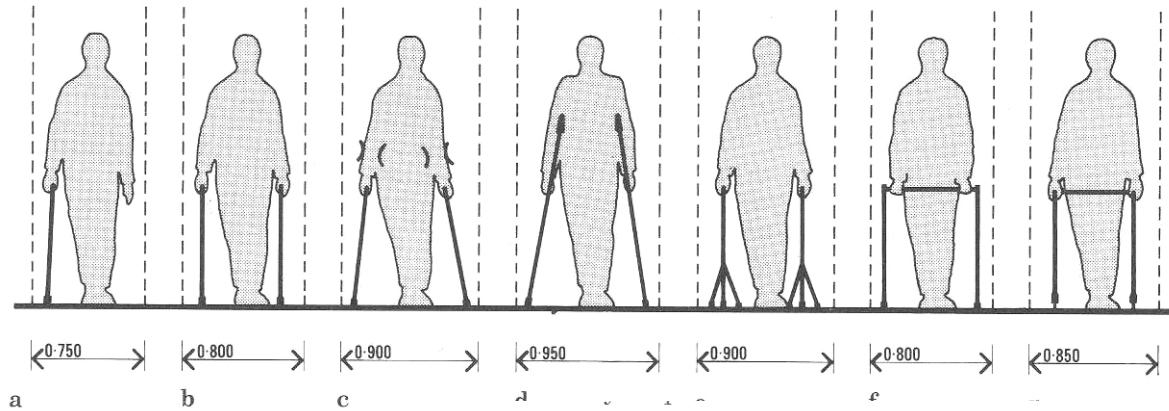
A space for people with walking aids – 1.800m (Goldsmith, 1984; pg148-154, 163).

Surfaces:

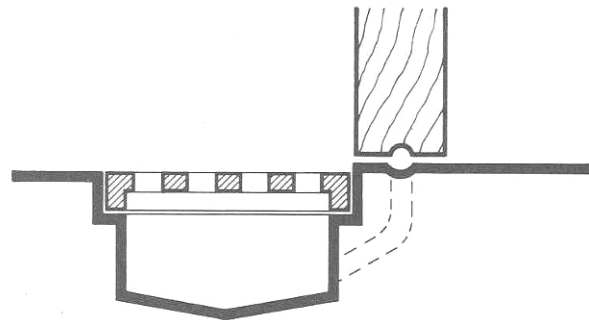
External surfaces need to be non-slip, to prevent accidents, but smooth enough for wheelchair movement. Fixed and firm materials. Unsealed gravel surfaces to be avoided. Where slabs or blocks are used joints must be flush. Paving slabs where used should have a carborundum or slightly corrugated finish to make it non-slip. Quartzite slabs are recommended. Patented rubber treaded paving flags may be used. A rough or porous brick is preferred to a smooth engineered brick. Dirt and marks are less conspicuous on a jointed or patterned surface, with an intermediate colour preferred to a light or dark colour (Goldsmith, 1984; pg163, 171).

Gratings:

Gratings can be a hazard for those using stick, crutch or wheelchair. Grating apertures should be no more than 20mm square, with bars minimum 13mm wide. Manholes should be flush with adjacent paving or road surfaces (Goldsmith, 1984; pg164).

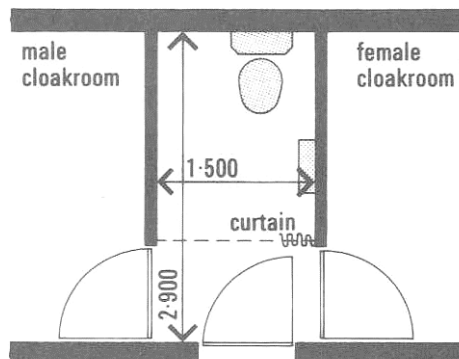


Goldsmith, 1984, pg153



34.3 Threshold grating over gutter

Goldsmith, 1984, pg176



Goldsmith, 1984, pg356

Parking:

Parking for disabled should be within 200 feet of the destination. Handicapped parking should be provided for, with a minimum width of 12 feet, and should be located closest to the centre of activity. Loading bays for handicapped people's buses should be 0.620m above parking bay level. (Goldsmith, 1984; pg322).

Thresholds:

Raised thresholds should be avoided. Where a sill is unavoidable as in the case of containing rain water a height of no more than 0.025m should be applied. Raised sills should be coloured to contrast with adjacent floor surfaces. An alternative is a pvc or vinyl strip which serves as a draught excluder and a water bar. External thresholds could be gutters with gratings over, flush with the surrounding surface (Goldsmith, 1984; pg176).

Public Bathrooms:

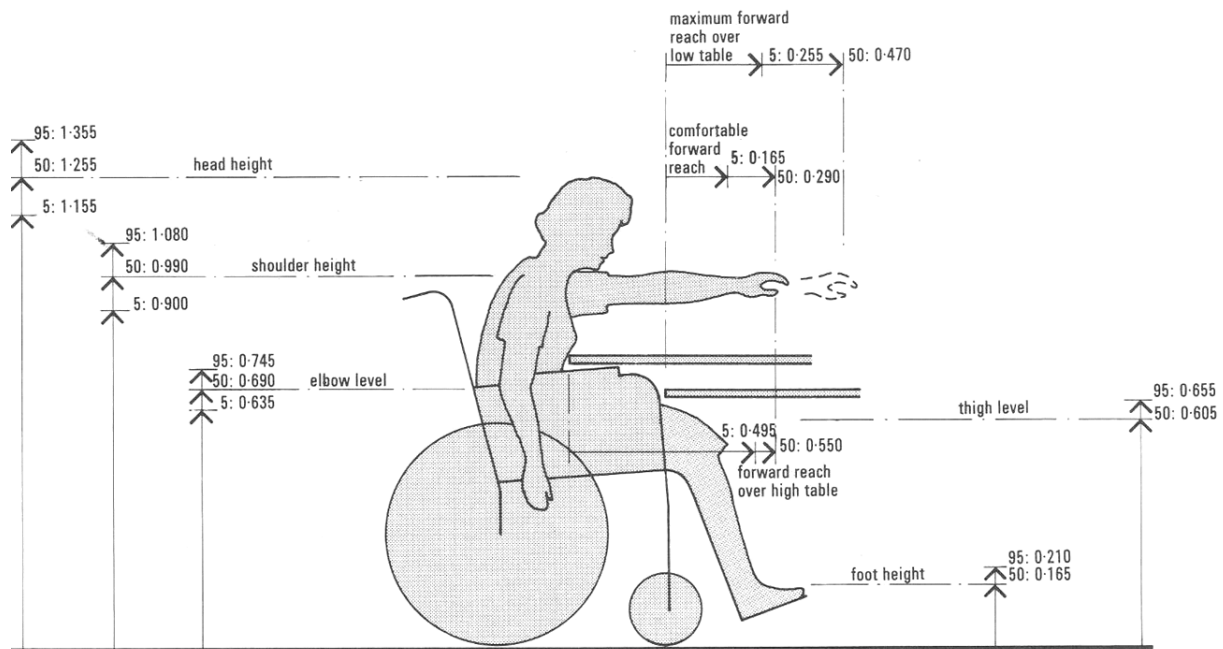
Doors into wc cubicles should give a clear opening width of 0.750m minimum and the doorset should be 0.900m minimum. The doors must open out or slide. The door must be hinged on the side away from the direction of approach. The cubicle should be no less than 2.000m deep and 1.500m wide. A space of at least 1.000m should be available to the side of the wc to allow transfer (Goldsmith, 1984; pg349).

Relevant Measurements and Ergonomics:

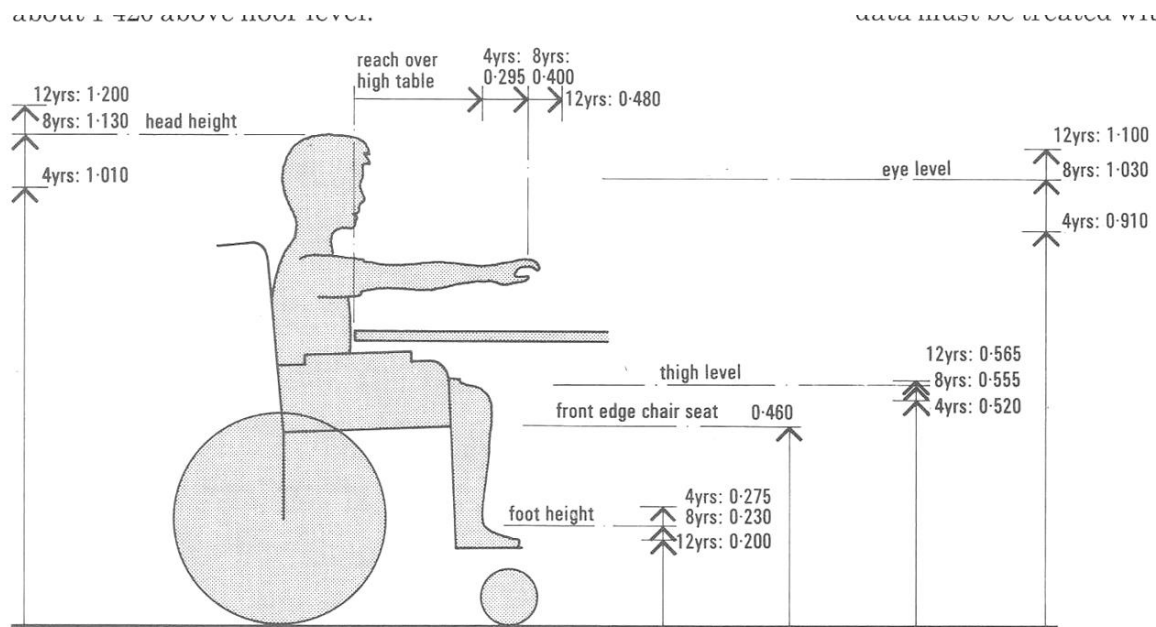
Designing for people with disabilities requires an understanding of not only the average measurements of these people, but in fact their minimum potential. In theory, universal design takes into account the least able of all possible users of a space or facility.

Adults:

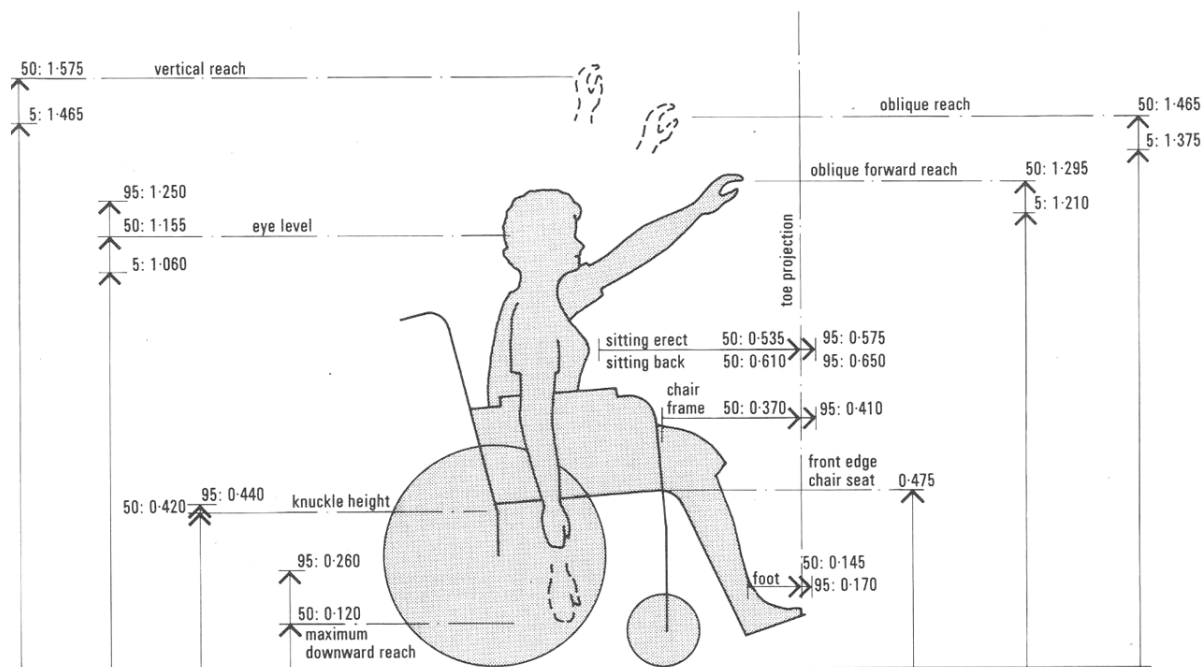
Maximum reach is considerably more than comfortable reach, but designing for the lowest common denominator requires taking the minimum of comfortable reach. The range of comfortable reach is only approximately as far as the wheelchair footrest (Goldsmith, 1984; pg121-122).



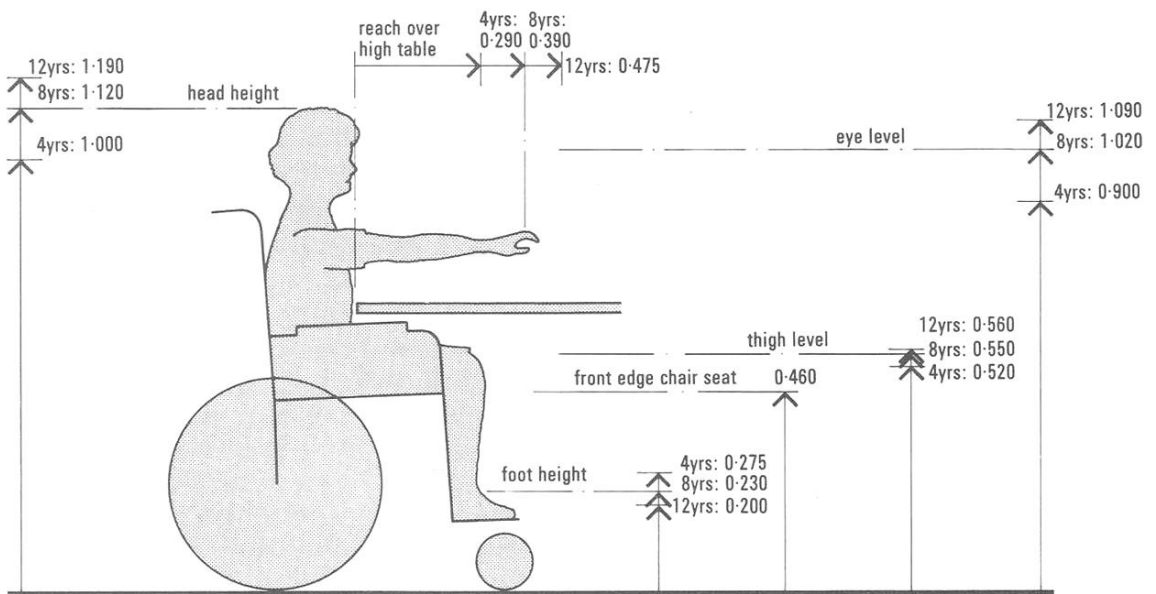
20.9 Anthropometrics: Chairbound women (1:20)



20.11 Anthropometrics: Chairbound boys aged 4, 8 and 12 (1:20)



20.10 Anthropometrics: Chairbound women (1:20)



20.12 Anthropometrics: Chairbound girls aged 4, 8 and 12 (1:20)

“a playscape is an outdoor environment designed to support and suggest activities that are an essential part of the child's learning and development (social, emotional, cognitive and physical)” Aase Erikson 1965 (Heseltine and Holborn pg16)

According to the national playing fields association playspace targets are applicable to all forms of play and recreation areas. Adventure playgrounds should be 1 per 8000 people, Equipped playgrounds 1 per 1000 people, Kickabout areas 1 per 500 people and Toddlers playspace 1 per 100 people (heseltine and Holborn, pg28)

Playground Equipment:

Swings areas must have an impact-absorbent incorporated beneath and around the area. Tunnels should be a minimum of 1meter in diameter. Tyres can be used as cost effective equipment in the form of stepping stones or edging when strapped or soldered together. p.g153. Seesaws should be install only those with a retarding mechanism. Seating is vital in play areas for parents and children. Sand pits should be raised above ground as a sand box not a sand pit and positioned in a quiet sunny area. A sand play area should also have flat surfaces or internal platforms for building on, removable cover's (some parents in the community may take responsibility for the key) and minimal equipment should be provided. Some form of a windbreak will make it more pleasant. Sand depth of 380-450 is recommended and sand grain should range from 1.5millimeters to very fine. Play houses, despite some parents fears, are essential to children's interactive play however completely solid sides are not recommended. Natural materials such as logs can be used as bridges or stepping blocks, they can also be used as borders or retainers but will require maintained. (Heseltine and Holborn pg153;144;141;139;132)

Playgrounds & play equipment for Children with special needs:

Slides should be fitted with handholds from top to bottom to help them sit or stand. Wide slides are also helpful but their installation will necessitate additional “normal” slide installation in the playground (Heseltine and Holborn; pg148). Textures provide location maps for children with visual handicaps & textural experiences for all children. Sand boxes should be raised for children in wheelchairs so that they may freely and independently access the sandbox (Heseltine and Holborn; pg 139)

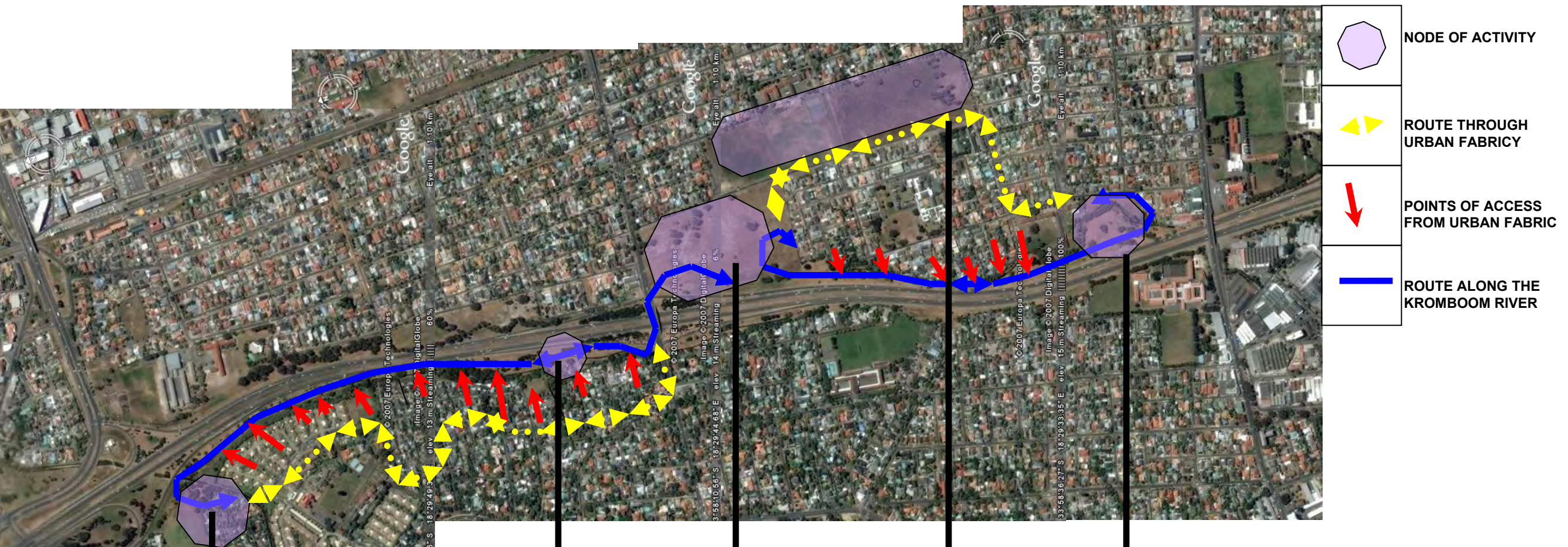
Kickabout areas & fields for Play:

Kickabout areas for football should be between 150 and 250 square meters, ball game areas need to have 20 to 40meters of clear space at least 10m from housing (heseltine and Holborn; pg101)



- Create coordination and continuity in planning and space making
- Links with various functions can enliven and create multipurpose spaces.
- Open space should be designed with the ideal that urban residents can access the public open space system in as short a distance as possible.
- Open space systems should be planned around existing natural features with great amenity value, and afford those natural systems protection from urban encroachment.
- Pedestrian links are vital as walking is the one mode of transportation that everyone has access to.
- Accessibility of green corridors and public open space should be equitable to all.
- Visibility and multiple access point are important in creating safe environments.
- Barriers are necessary in some cases, but should be avoided as much as possible.
- Open space and green corridors can act as links not only in terms of space but also in terms of social divides.
- Natural rivers should be kept pristine if at all possible.
- When modifying a river, try to stay as close to the way it was in its natural state.
- Passive river modification, involving the entire catchment area at a low level of intervention, is a better solution than aggressive canalisation on the specific length of river.
- A natural river contains many varieties of habitats, all of which have to be exactly as they are to preserve the life they contain. Canalised rivers have no ability to provide the variety necessary for life to flourish.
- The disabled person is the lowest common denominator in society. Designing with the disabled in mind will produce a space which can accommodate all people equally well.
- Ramps are better than stairs where possible and should be kept to as gently a slope as possible.
- Surfaces need to be rough enough for wheel chairs to retain grip, but not too rough for easy movement.
- Thresholds need to be flush as often as possible, and where it is not possible, a ramped entry or raised crossing should be provided.
- Children learn and socialize while they play, so provide spaces capable of encouraging learning and socialising.
- Play equipment that requires cooperation to use accelerates the ability of children to work in a team environment.
- Use durable yet pliable materials when designing spaces for children, so injuries are avoided as much as possible.

PROPOSED FRAMEWORK PLAN AND DESIGN INTERVENTION



CONFLUENCE AREA OF BLACK RIVER AND KROMBOOM RIVER. GREAT POSSIBILITIES FOR DEVELOPED OPEN SPACE NODE. ABUTTING EXISTING SPORTS FACILITIES. GOOD ACCESS TO PROPOSED PEDESTRIAN ROUTE.

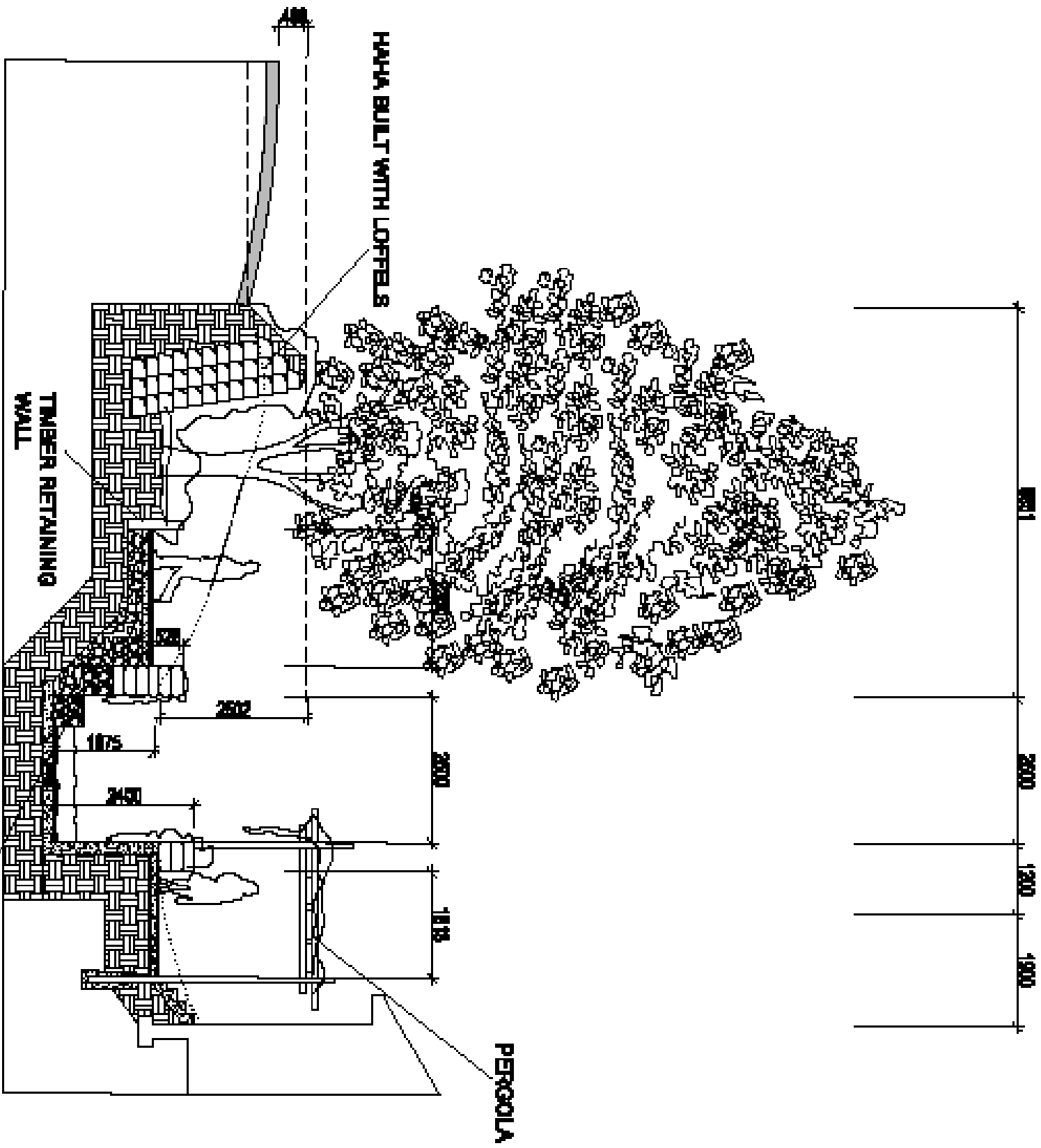
LARGE OPEN SPACE WITH EXCELLENT POSSIBILITIES FOR PARK, BRAAI AND KICK ABOUT. ADJACENT TO AN EXISTING PARK, COULD BE INCORPORATED INTO THE OPEN SPACE SYSTEM. GOOD ACCESS TO URBAN ENVIRONMENT POSSIBLE.

LARGE OPEN SPACE OF INDETERMINATE FUNCTION. AS YET UNDEVELOPED. EXCELLENT POTENTIAL FOR CONSERVATION AREA WITH OTHER ATTACHED FUNCTIONS. POINT ON ROUTE OF CROSS OVER KROMBOOM BRIDGE OR TURN BACK IN A LOOP TO RETURN TO RIVER PARK.

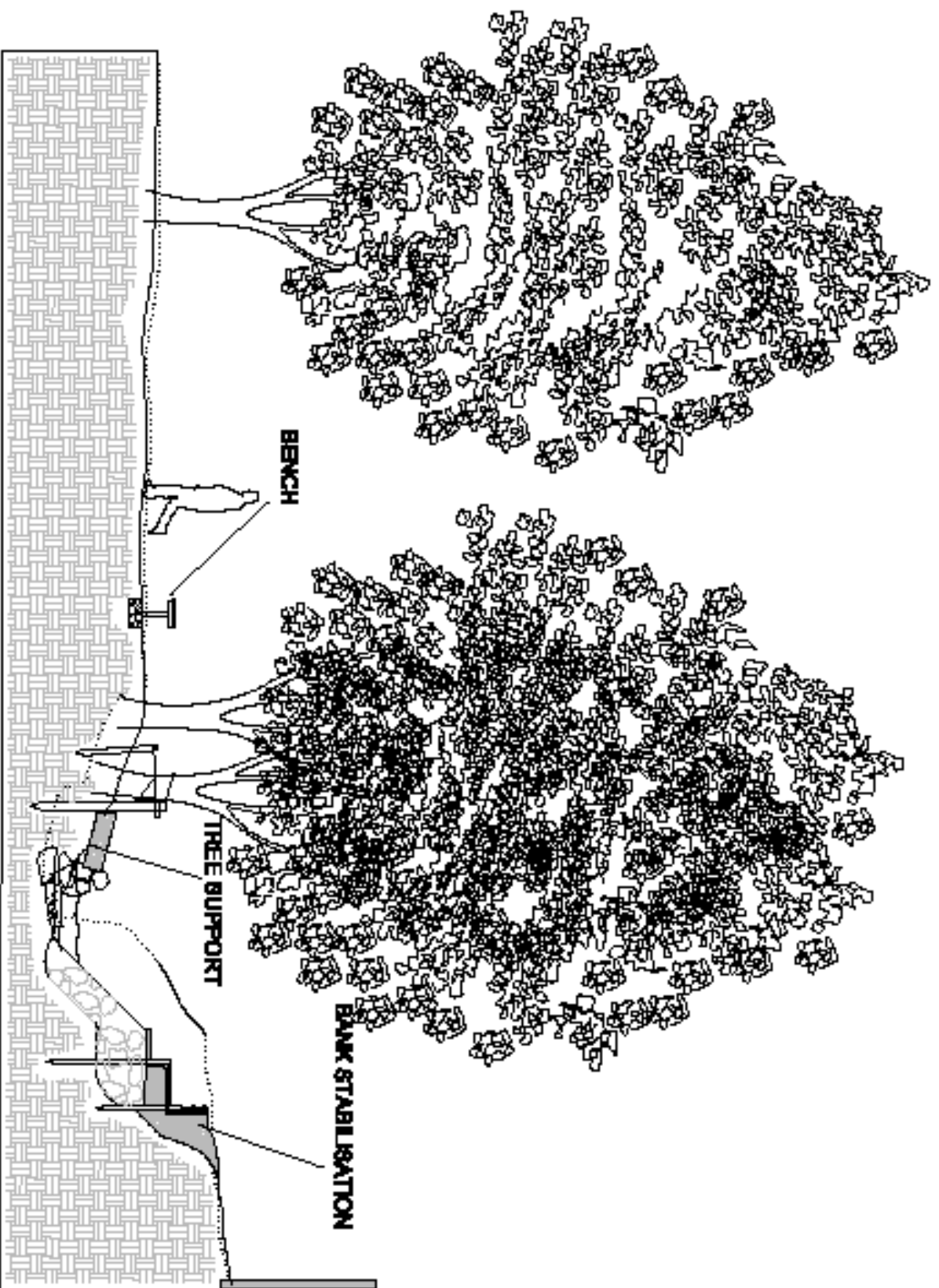
RONDEBOSCH EAST COMMONS ALREADY PART OF OPEN SPACE SYSTEM. GREATLY UNDERUTILISED. LARGE POTENTIAL FOR CONSERVATION AND EDUCATION. FORMS PART OF URBAN PEDESTRIAN AND CYCLE ROUTE.

RIVER PARK, FORMS MAJOR ENTRANCE POINT ONTO THE KROMBOOM PARKWAY PEDESTRIAN ROUTE. GREAT POTENTIAL FOR RECREATION AND FOR RIVER REHABILITATION

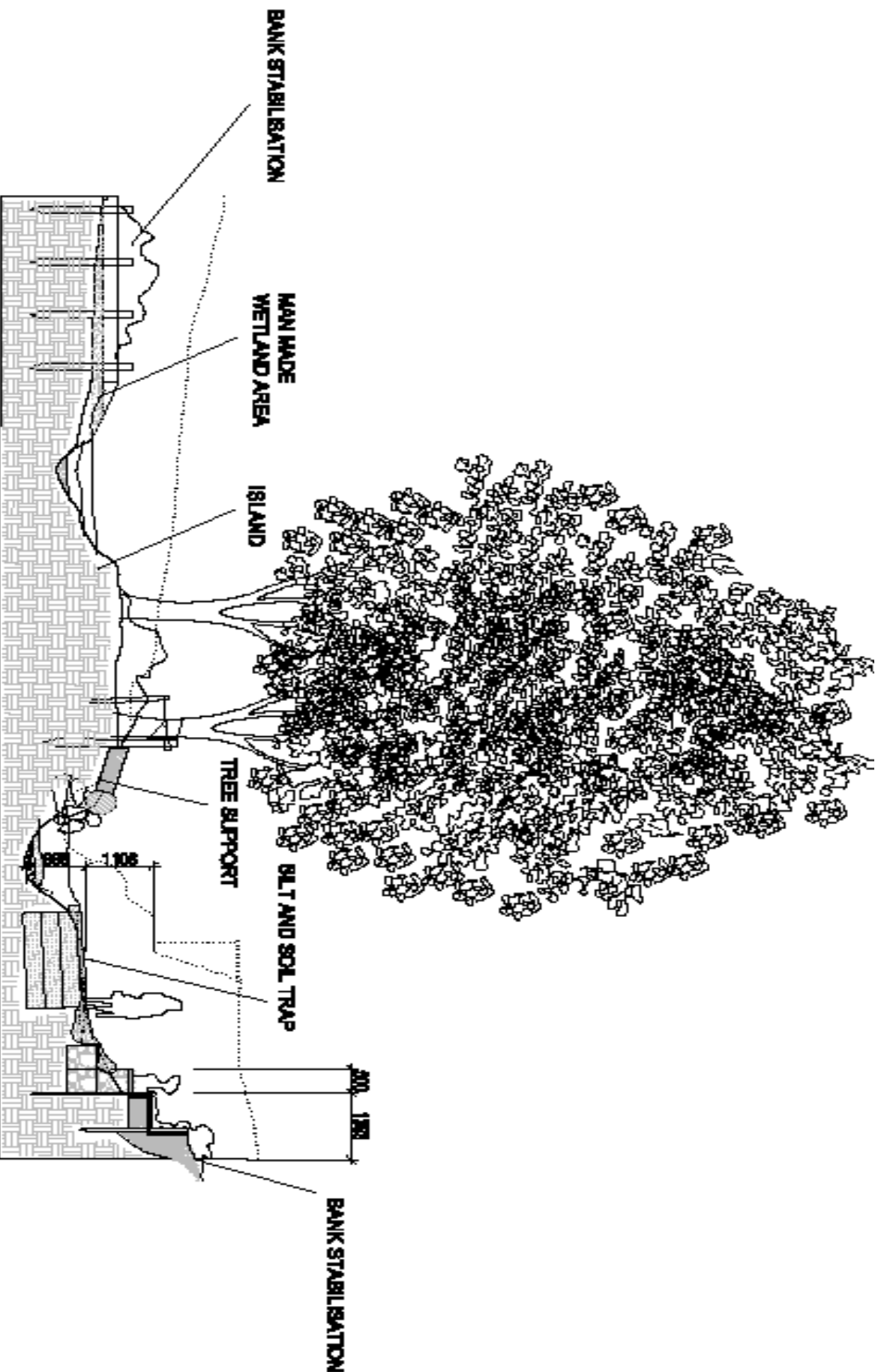
The system of public activity is a concept of a linking system which joins all activator spaces with developed and undeveloped public open space. The routes used as linkages are part of the urban fabric with large potential for pedestrian movement, already heavily travelled in most cases. The core of the concept is the Kromboom Parkway, from which all the linkages extend outward to link the surrounding neighbourhoods to the system of public activity and to their adjacent suburbs. The core of the Kromboom Parkway is the Kromboom River, without which the pedestrian trails would be less recreation and more access routes. To redesign the River Park as an enticement onto the pedestrian route is a logical step. To maintain the momentum the system of trails and pedestrian friendly design interventions along the route have to form a legible route with good access and points of activity. Once this system is well established and has received acceptance from the surrounding inhabitants, the new linkages to other spaces may begin to extend.



GENERIC SECTION OF PEDESTRIAN ROUTE THROUGH NARROW SPACE ALONGSIDE HIGHWAY



SECTION THROUGH RIVER PARK WHERE EROSION AND UNDERMINING OF TREES ARE PROBLEMS



SECTION THROUGH RIVER PARK WHERE SANDY BAYS AND WETLANDS ARE CREATED

BOOKS AND JOURNALS

City Engineer's Department; *Greening the City - Open Space & Recreation Plan for Cape Town*; City of Cape Town; Cape town; 1982;

Wenche E. Dramstad, James D. Olson, and Richard T.T. Forman; *Landscape Ecology Principles in landscape architecture and land use planning*; Harvard University Graduate School of Design, Island Press, American society of landscape architects; United States of America; 1996;

Moughtin, C; *Urban design – Green dimensions*; Architectural press, an imprint of Butterworth-Heinemann, a division of Reed educational and Professional Publishing Ltd; Oxford, Great Britain; 1996;

Davies, B.R. Day, J.A; *The biology and conservation of South Africa's Vanishing Waters*; The centre for extra-mural studies, University of Cape Town; South Africa;

McHarg Ian L.; *Design with Nature*; Published for the American museum of natural history, Doubleday & Company Inc; New York; 1971;

Jaspert Julie, Cavanagh Sue, Debono Jane; *Thinking of small children: Access, provision and play*; We welcome small children campaign, women's design service and London Borough of Camden; Great Britain; March 1988;

Untermann Richard. K; *Accommodating the Pedestrian*; Van nostrand Reinhold company Inc; United States of America; 1984;

Brambilla Robert, Longo Gianni; *For pedestrians only, Planning, design and management of traffic-free zones*; Watson-Guption publications; New York; 1977;

Tilanus Edward Frank; *The Conservation worthiness of the environment of the Black and Liesbeek river confluence area*; submitted to the University of cape Town in partial fulfilment of the requirements for the degree of master of Philosophy in environmental science; June 1994;

Luger, Michael Karl; Dissertation Engeo Library University of Cape Town; *Environmentally-sensitive river management: Assessment and mitigation of impacts on urban rivers*; 1998;

Dattner Richard AIA; *Design for play*; Reinhold Book Corporation, MIT press paperback edition; United State of America; 1969;

Heseltine Peter, Holborn John; *Playgrounds – the planning, design and construction of play environments*; The Mitchell Publishing company Ltd; Great Britain; 1987;

Littlewood Michael; *Landscape detailing*; 3rd edition; Architectural press, an imprint of Butterworth-Heinemann, a division of Reed educational and Professional Publishing Ltd; Oxford, Great Britain; 1997;

Lisney Adrian; Fieldhouse Ken, editor Jeremy Dodd; *Landscape Design Guide – Volume 1: soft landscaping & Volume: 2 Hard landscape, The design of paved spaces, landscape enclosure and landscape furniture*; Gower publishing house; Great Britain; 1990;

Ledermann Alfred, Trachsel Alfred; *Playgrounds and Recreation Spaces*; Architectural Press London; United Kingdom; 1959

Goldsmith Selwyn; *Designing for the disabled*; RIBA Publications Limited; England; 1984;

Environmental Baseline Study for Land-Use Decisions in the Liesbeek River Confluence Area, 1993-1994 Masters Class, Department of Environmental and Geographical Science University of Cape Town

Editor: Carol Knoll; *Environmental Planning and management*; Journal volume 6; No.3; Phase 4 (pty) Ltd; South Africa; May 1995

Aurand Douglas C; *Fountains and pool: construction guidelines and specifications*; PDA Publishers Corp; Mesa, Ariz; 1956

Izembart, Hélène; *Waterscapes: using plant systems to treat wastewater*; Herbert; Gustavo Gili; Barcelona

Wylson A; *Aquatectur : architecture and water*; Architectural Press; London; 1986

J. McCluskey; *Roadform and Townscape*; Butterworth-Heinemann; Boston; 1992

Luger and Davies; *The Rehabilitation of over-engineered urban rivers, options for the Liesbeek River in Cape Town*; Earthyear vol 7

Oberholzer Bernard; *Constantia Valley River Study*; Ninham Shand consulting engineers, MLH architects and planners; 1993

Dreiseitl, Dieter Grau, Karl H.C. Ludwig; *Waterscapes: planning, building and designing with water*; Birkhäuser; Basel; 2001

Cleary L; *The liesbeck/black river Confluence Area: A development Framework*. Masters Thesis in City and Regional Planning; University of Cape Town; 1995

MOSS; *Metropolitan Open Space Systems. Report of Proceedings International Conference*; Wildlife Society and Durban City Council; Durban; 1994

City Planners Department; *Planning of metropolitan Open Space in the Cape Town metropolitan area. Discussion document*; Cape Town city council; Cape Town; 1994

Council For the environment; *Guidelines for environmental conservation and environmental creation in structure planning for urban environment*; Joan Lotter publications; Pretoria; 1989

INTERNET

Manual of river restoration techniques, RRC – Web Edition, 2002; The river restoration centre; England

IMEP: integrated metropolitan environmental policy – city of Cape Town; Oct 2001; www.icleieurope.org/fileadmin/user_upload/ITC/worldcongress2006/CT_IMEP_strategy.pdf

City Parks Development Policies for City of Cape Town; Oct 2004; web.capetown.gov.za/eDocuments/City_Parks_Development_policies_6620071526_.pdf;

Science 29 April 2005; Vol. 308, no. 5722, pp. 636 – 637; DOI: 10.1126/science. 1109769; Policy Forum, ECOLOGY: Synthesizing U.S. River Restoration Efforts;

<http://www.sciencemag.org/magazine.dtl>

[Environmental Resource Management](http://www.capetown.gov.za/soe); City of Cape Town 2001 - 2007 www.capetown.gov.za/soe

Socio-economic characteristics of suburbs; city of Cape Town; 1996; www.capetown.gov.za/reports/pdf/sociosuburbs.pdf

Audouin Michelle, Muller Elizabeth, Neal Marian, CSIR; *City of Cape Town sustainability report, phase 1: Draft set of indicators*; Prepared for craig Haskins and Kieth Wiseman: Environmental management Department, City of Cape Town; July 2004