SMALL SCALE RIVERS, LARGE SCALE IMPACT

THE RECONNECTION OF MAN AND NATURE THROUGH THE PURIFICATION OF NATURAL RESOURCES

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Figure 2.8.17: Seating bench construction detail for hydroponic beds. (Author, 2015)

ABSTRACT

The increasing demand and pollution of natural water systems caused by the constant growth in population has placed maximum strain on the resources upon which people depend. The presence of water sources has ensured the establishment, development and progression of the urban environment since settlements first originated, however, these environments have grown beyond the resources capabilities to sustain them. The preservation, purification and sustainable use of water have quickly become the most important strategies ensuring the survival of the urbanized world and its inhabitants.

The loss of water as a resource as well as their ecological systems and processes is not limited to larger water sources but is evident in the smaller scale river systems that are exposed to the urban environment on a daily basis. The demands by the surrounding urban environments exceed the capability of these smaller river systems which in turn has led to their neglect and steady destruction.

This study investigates the potential of small scale urban river systems to be able to provide for the surrounding urban environment as a resource through the process of purification. The reintroduction of the river as a resource will instil a sense of stewardship in man over the natural environment on which they rely, focusing on the connection between man and nature. The transformation of the riverfront into an interactive public space will promote the use and interaction of people with a previously neglected environment. The strengthening of the connection between man and environment is achieved through the incorporation of the resource into the economic sector of the urban environment, using the river as a means of income and production will add considerable value to the natural environment.

A broad approach was investigated that took the entire river system into consideration, while the main design intervention took place at one specific point along the river which had potential in all social, ecological and economic aspects. A decommissioned, post-industrial site was selected into which the purification of the river system could be integrated. The purification of the river would allow for various degrees of use, interaction, education and production centred around the resource. The proposal creates opportunities for the creation of public space and economic activities which benefit the surrounding communities through the rehabilitation of a polluted urban river. The incorporation of the river system into the post-industrial site is responsible for the rehabilitation and reclamation of a wasted landscape into one of provision and connectivity between various aspects of the urban environment.

The purpose of the intervention is the re-introduction of an existing urban river system into the built environment through the creation of social, economic and ecological connections, re-capturing the significance, importance and potential they hold as a resource as well as the ability to inform urban spatial design.

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PART 1: THE POWER OF RESTORATION AND REHABILITATION

CHAPTER 1: THE REAL WORLD PROBLEM

INTRODUCTION

There is a constant struggle between the artificial environment of the city and that of the untouched natural environment.

The demand of the natural environment to consistently meet the needs of the populace is seen to eventually deplete and destroy the very resources which were responsible for its initial existence.

As urbanization increases so the rural lands decrease, it is the blind forces of urbanization which develop along the lines of least resistance that are responsible for the depletion of resources on which it so harshly depends. There is a certain consciousness surrounding the depletion of resources by the urbanized world in the name of progression.

Through the continuous and increasing congestion and the widening expansion of urbanized environments, it is no longer only the natural landscape which suffers, areas of the urban environment which have run their course and are no longer of a beneficial nature will face the same neglect, defacement and degradation as that of the natural environment.

Focusing on the depletion of water in particular, there are various levels on which water has been responsible for moulding the existing world into place over centuries of discovery and development. As the source of all life, there is a certain degree of understanding and respect with which the developing world should incorporate the resource into a daily way of life. Through reassessing and re-evaluating the role water systems have played within the urban environment as well as the ever evolving relationship between user and resource, one will gain an understanding in the progression and significance of the use of urban river systems within the built environment.

There has been significant movement in the direction of environmentally sustainable design as well as an attitude of stewardship on a global scale, moving away from the previously human dominated uses of water which inherently had an effect on ecological properties.

There is however a necessity for the initiatives to be adopted not only in large scale river cities but in all freshwater resources which are negatively affected by the urban environment and have the ability to directly influence people's lives.

The future design of urban cities as well as human survival lies in the development of mutually beneficial relationships between urban environments and their water systems, where human interventions in such systems becomes a strength rather than a liability of the system.

THE INFLUENCE OF URBANISATION ON URBAN RIVER SYSTEMS

The progression of urbanisation was directly responsible for the continuous decline and degradation of the natural environment, as urbanisation increased so the state of the natural environment steadily decreased.

There is a point reached where city development and the resultant population have outgrown their local water supply.

The natural resources which were responsible for their initial establishment are no longer able to sustain the needs and requirements of the surrounding environment. As a result, cities begin to rely on distant water bodies and systems as a resource while existing rivers are barely used as resources, ultimately serving the urban area as an element of disposal and management for negative products of the industrialised and developed environment.

As cities were establishing they were able to obtain substantial volumes of pure water to support the dependent population as well as able to dispose of the produced wastes with minimal impact and influence on the natural environment. It is essential that the development of waste management and infrastructure of the urban environment develop at the same speed as the rate of overpopulation and pollution increase. Failure to do so will result in the significant decrease in the quality of urban rivers, not only will they no longer be able to be used as a resource, but evolving into a hazard to their surrounding environment (Ellis 2011. para. 1-2).

Urban rivers bear the brunt of the cities industrial effluent, urban runoff and untreated sewage, stripping these resources of their aesthetic and ecological value and resulting in the transformation of large green areas into neglected, deserted areas with little, completely restricted or no access. The rivers, which were solely responsible for the city establishment, have become disassociated and disconnected from the urban environments.

When reassessing and re-evaluating the value of the river system within its current context, it is necessary to understand the historical background surrounding the use of and influence that river systems have had on the developing environment.

The river was strongly associated with urban development regarding its use as a a resource as well as urban design tool.

Photo1.1.1: Moreleta Spruit running through rural residential area (Author, 2015)

Photo 1.1.2: Moreleta Spruit pollution and litter. (Author, 2015)

Rivers as a Resource

The presence of water played a significant role in the identification and eventual colonisation/habitation of an area, more permanent settlements were established through the systemic cultivation of plants and the domestication of animals, both of which were heavily reliant on the presence of water.

The more reliable the available water source was for irrigation and domestic use, the more stable the settlement was, resulting in a greater opportunity for development and progression. It took the production of surplus storable food, more complex social organization and technological advances to meet the requirements of the 'urban revolution'.

Ultimately, cities were established at the intersections of transportation routes or points where goods are required to shift from one mode of transportation to another, such as land to rivers and ocean ports. (Ellis, 2011. para. 1)

Cities serve as centres for manufacturing, storage and trade and it is the surplus produced from the outskirts of the cities which are distributed throughout the centre, developing around marketplaces and the exchange of produce between rural and locally produced goods.

Rivers as an Urban Design Tool

The locations of cities were determined through the presence of water as a resource, but the spatial organization of the city itself was further influenced on various levels by the river system. As cities grew and established themselves, the complex social organization of cities demanded segregation and separation. (Ellis, 2011. para. 4).

Urban Rivers served as a dividing line between settlements, used as a form of natural boundary or barrier between various races, population groups, farmlands and industrial properties. Later through increasing industrialisation, increased migration and social division, these rivers became an important line of separation, a natural boundary, between ambiguous territories marked by racial segregation, conflicting uses, contradictory conditions and constant change.

As the development of urban environments took place, urban rivers were further recognized in terms of protection of nature, fisheries, recreation as well as their considerable value in contribution to the landscape.

These rivers over time were continuously used and adapted for use beyond irrigation, domestic use, fishing and transportation but were slowly but surely incorporated into the industrial environment. (Gardiner 1997 cited in Cengiz 2013. p. 1).

The natural elements of the landscape on which cities were established were taken into consideration as a means of design and spatial configuration of the urban city layout.

The arrangement of networks, buildings and open space in various ways would give rise to the ultimate urban structure for the most functional city designs.

Photo 1.1.3: Restricted access to Moreleta Spruit (Author, 2015)

Photo 1.1.4: Security and restricted access surrounding Moreleta Spruit (Author, 2015)

It is essential to understand the potential of urban river systems to act as a connection between landscapes and communities.

The open space surrounding urban river systems provides for the presence of natural river habitat. The future design of cities needs to incorporate urban rivers and urban river systems as a link between open spaces, throughout the urban environment, such as parks, gardens, lawns and nature reserves which provide for an essential break from the harsh urban environment.

The abundance of green space and exposure to such environments, increases the aesthetic value of the areas and renders them desirable areas to live in.

However, it is essential to understand the implications of the development of green areas, even though green spaces are responsible for the further depletion of the natural river habitat, these spaces are often designed with certain planting and activity implications, disrupting the natural ecological processes, which in turn decreases the biodiversity and species richness in these areas.

This, along with the increased development of industrial facilities, residential areas, freeways and commercial areas infringing on the flood lines of the river system, leaves little to no protection of the natural environment. (Davis and Jensen 2015)

Many of the world's greatest cities have been established along the banks of fragile river systems, requiring specific design interventions for the preservation and protection of the urban environment from the potential threats of the natural environment.

There is a level of initial connectivity designed between the cities and their respective riverfronts, indicating how the riverfronts were initially established and later designed and defined as public spaces.

The urban environment has however come to dominate the natural environment, and a shift in perspective in terms of hierarchy between nature and man is required to ensure sustainability.

Past uses of rivers and social tendencies have affected the present conditions of rivers, and the struggle is no longer between man and the natural environment, it is in the transition between the anthropocentric mind set and that of stewardship, the responsible planning and management of resources is the only option if man is to survive. (Smardon 1995 cited in Cengiz 2013. pg. 1-3).

Photo 1.1.5: Unrestricted access to Moreleta SPruit and green space in residential area. (Author, 2015)

EXAMPLE OF INTERNATIONAL URBAN RIVER CITIES

The Thames River, Victorian London

There are various aspects of connectivity throughout a number of historical river cities of the world.

The Thames, before the great embankment was built, was responsible for supporting lives and livelihood in physical proximity to its water.

The construction of the embankment was responsible for the alteration in the relationship between the user and river system, with the great brick and granite walls sealing off all access to the river, thereby restricting access to people who had no legal or bureaucratic right to work on it. The river was no longer a working thoroughfare, but had become a subject of engineering reports and water quality surveys.

Due to the level of pollution, the river had become a main source of disease transmission, and the design of the embankment was aimed at the interruption of the ecological connectivity in order to prevent this transmission, resulting in the loss of traditional river occupations and utilisation.

After the complete exploitation and degradation of London's economic and natural life line, the solution was to hide the pollution through channelization and the construction of a wall around the river, thereby removing the pollution from site, but not resolving the base line problem.

The construction of the barrier between urban and natural environments completely limited the interaction between man and river, however there was the development of a public promenade along the river's edge, creating a vantage point from which the river could be enjoyed as a social amenity.

The lack of physical connectivity to the river system and limited understanding of the natural systems and processes was a inhibiting factor in terms of value of the river and understanding of the river system. (Porter 1998 cited in May 2006. pg. 480)

Picture 1.1.1: Thames River in London Urban Area - Modern Day (D, Harris, 2014)

Photo 1.1.6: Thames River in London Urban Area - Mid 1900's (D, Sim. 2014)

EXAMPLES OF LOCAL URBAN RIVER CITIES

The Orange River, South Africa

Although not related to one specific establishment, the Orange River is responsible for the establishment of a number of cities, towns and settlements along its course, providing for a large section of South African rural and urban development. Its value as a resource is unmatched by any other river in the country.

The Orange River, is one of the longest rivers, not only on the continent of Africa, but South of the Tropic of Capricorn. It originates in the Lesotho highlands, draining into the Atlantic Ocean in a generally westerly direction. It transverses the veld region of South Africa and is responsible for defining the boundaries between provinces and countries.

The drainage basin of at least 855 000 square kilometers is unamenable to cultivation without irrigation in the western half. ('Orange River' 2015)

There are two large river projects, the Orange River Project and the Lesotho Highland Project, designed and in the process of construction, to meet the water demand for irrigation, increasing urbanization and economic development in the central industrial areas of South Africa.

The main tributary of the Orange River is the Vaal River, which flows through the major population and industrial core of the country later turning south to join the Orange River.

The high valleys of the Orange River headwaters are uninhabited by major populations and urbanization, however adjacent plateaus are used as rural grazing lands. Sections of the river further south are used for maize cultivation and grazing.

There are highly irrigated sections of the river used for agriculture and growth of cotton, lucerne, grapes and dates as well as the presence of a number of scattered farms within the reach of the rivers freshwater supply. There are no large towns situated along the riverbank, yet the river is still used for the provision of water to a number of large cities such as Johannesburg. (The Department of Water Affairs, South Africa n.d)

The unchanged natural state of the river has had an effect on the development of large irrigation and hydroelectric projects due to the high amounts of silt which clogs reservoirs and limits storage capacity.

The Orange River Project was developed as a result of the drastic increase in population and the associated development needs and demands. The porject aimed to utilize the water from the lower catchment of the Orange River for extensive irrigation schemes, generation of hydro-electric power and urban water supply, meeting the ever increasing demand for food and water.

The main aims of the project revolved around the use of the river system as a sustainable reource, making provision for new irrigation development along the river at various areas within reach of

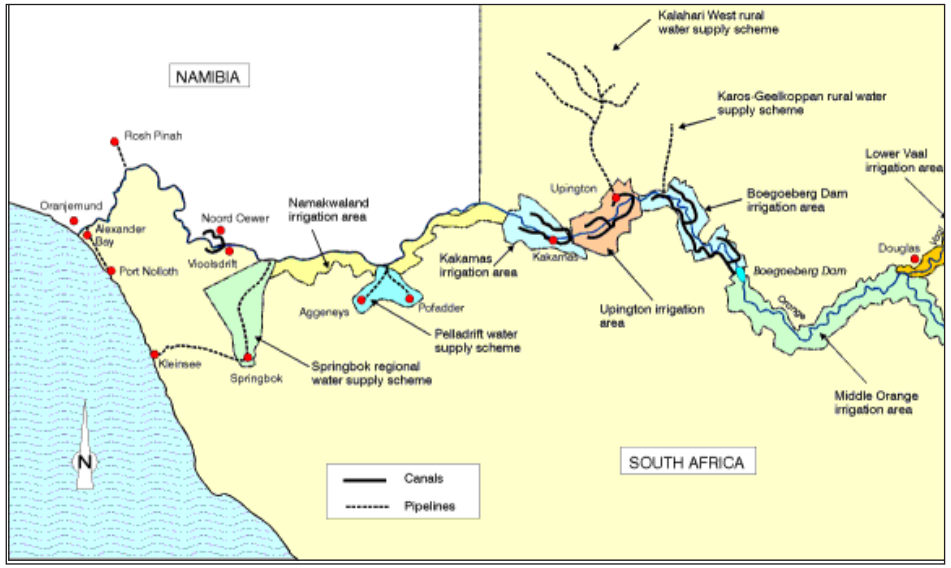

Image 1.1.1: Map of Orange River (The Department of water and sanitation, 2015)

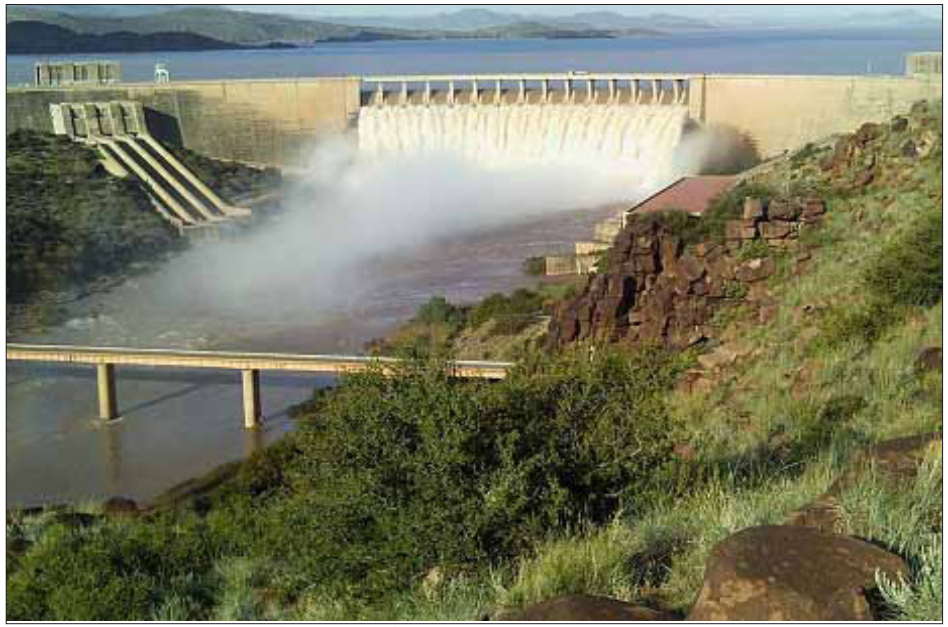

Photo 1.1.8: Gariep Dam Wall (Aliwal. 2011)

Photo 1.1.9: Orange River Irrigation Scheme1.1.1 (J, Dippenaar, 2010)

the river, stabilizing the water supply to existing irrigation schemes, higher water quality to water deficient associated rivers, to supply water to various urban centers and the generation of hydro electricity.

The project would be responsible for a number of positive outcomes throughout South Africa such as:

1. Increase in agricultural production.
2. Making provision for a large number of irrigation farms.
3. Allowing for the production of meat and agricultural crops.
4. Promoting economic activity and development in the areas directly involved with the river.
5. Creation of stable farming communities, thereby counteracting the migration of the rural population to the cities.
6. Promotion of tourism and recreation.
7. Flood control and protection of riparian zones and irrigation streams.

Constant analysis and management of the Orange River is required in terms of the evaluation of efficient and sustainable use of the water resource, the quantity of water available for development and use, as well as the influences of further development on the hydrology and water quality of the river and surrounding environment.

The Gariep Dam is the main water storage dam in the Orange River system. This dam, along with the Vanderkloof Dam, support hydro electric schemes belonging to Eskom, and were responsible for the storage of water for irrigation schemes established in Buchuberg, Upington, Kakamas and Vioolsdrif.

The river is also available for rafting and canoeing in the summer months and holds great historical economic value in the South African diamond mining indudtry, with the first diamonds in the country being discovered in alluvial deposits on the Orange River.

In terms of water quality and the constant increase in urbanisation and population growth, it is impossible for the water resource to sustain the current pattern of consumption. Despite the looming water crisis, consumption by agriculture, industry, mining and household demand are increasing and placing further strain on the water supply through pollution and hydrological disturbances.

The main impacts of the urban environment on the river system are erosion, mining and mineral processing, industrial/agricultural/domestic effluent released into the river, poor and inappropriate waste disposal and indiscriminate dumping. ('Orange River' 2015)

The Orange River is responsible for the water provision along the length of South Africa, maintaining the economic sector and providing for the urban and rural environments. Therefore a drastic change in the impact of the urban environment on the river system is necessary to ensure sustainability and the increasing demand on the environment.

PROBLEM IDENTIFICATION

The progressive decline in the urban river resources and freshwater ecosystems as a whole, has led to the focus on rehabilitation and preservation of natural resources.

With water systems surrounded by urban environments, there are certain social, ecological and economic implications which need to be taken into consideration when addressing urban river rehabilitation. The neglect, separation, degradation and pollution of urban rivers and their surrounding environments is not confined to a specific country, region, population or grouping, it is a problem faced on a global scale, common to all areas which are subject to urbanization.

Man is entirely reliant on the availability of usable fresh water, and the lack thereof will undeniably cause the unravelling of not only man, but all life on earth. The continuous irresponsible use of water systems is responsible for the gradual destruction of the resource as well as its ecological functioning.

Using urban rivers and streams as dumping sites and waste removal channels is the direct cause of the increased alienation and separation between urban dwellers and the now polluted natural resource. An alternative approach is required to the way in which water is treated, consumed and managed within the built environment, there is no possible future without the presence of water as a usable resource. (Davis and Jensen 2015) (RC: His & contemp)

HYPOTHESIS

Integration between the life of the city and its waterfront will aid in the promotion of human access to and interaction with the riverfront and water systems, through the use of conceptual, visual and physical connectivity between urban and natural environments. The interaction between user and system in a manner which will raise awareness in the complexity and importance of urban river ecosystems will increase interest in ecosystem integrity, ultimately providing clues for the appropriate use of those systems.

DESIGN STATEMENT

The investigation of polluted small scale urban river systems will establish how treatment and rehabilitation initiatives require a design response which will re-establish various levels of social, economic and ecological connectivity throughout the water system.

TECHNICAL QUESTION

How will the improvement of ecological functions within the river system be resolved while simultaneously increasing access and integration between the urban and ecological environment as well as minimizing the anthropogenic influence of the urban environment on the water resource?

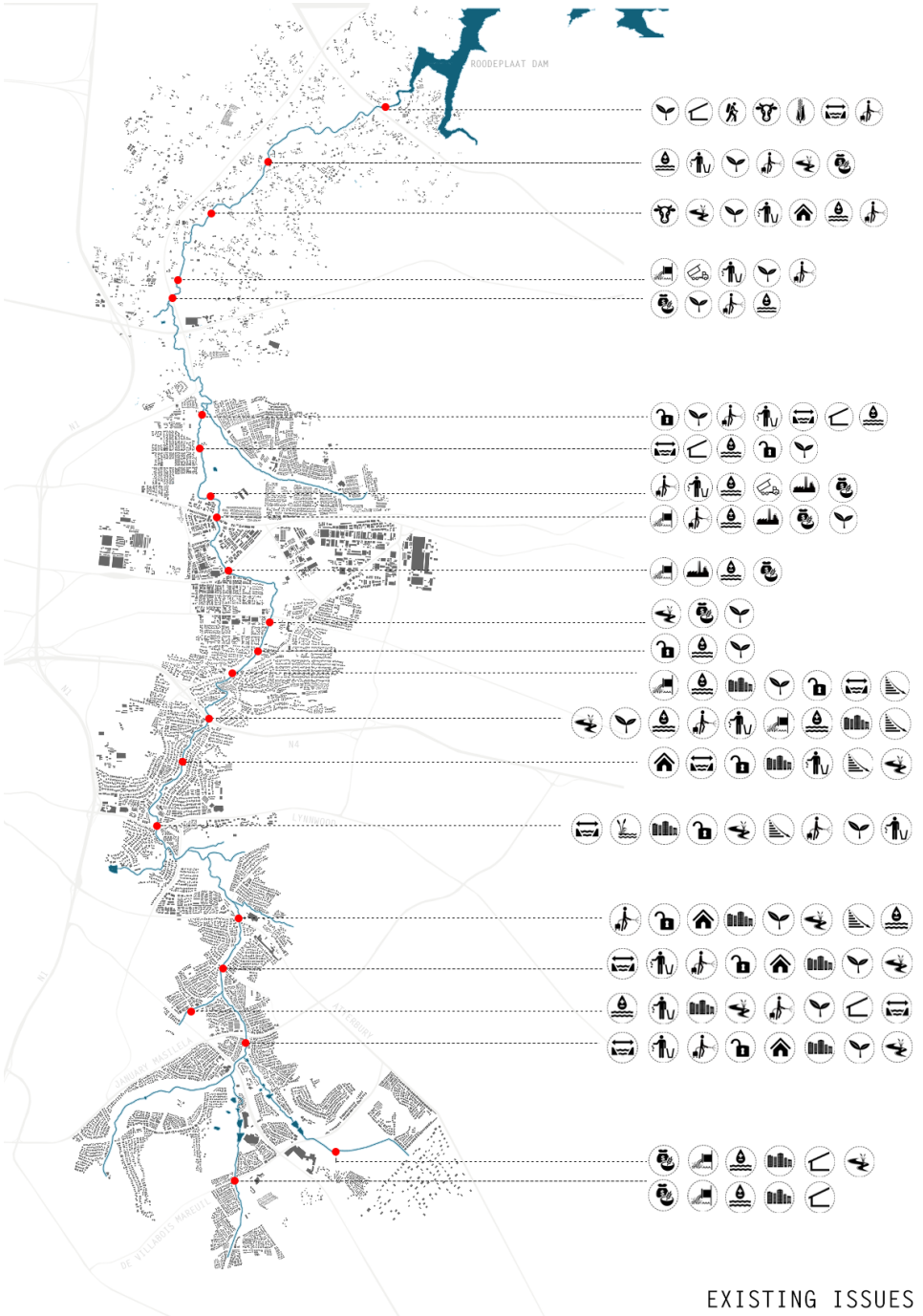

Figure 1.1.1: Mapping of issues encountered along the course of the Moreleta Spruit (Author, 2015)