The Development of Elsburgspruit Catchment Remediation Plan

By

Johan Barnard

Introduction

- CoE known for numerous waterbodies, wetland & river systems.
- CoE faces many challenges in managing and protecting these due to minimg, massive urbanisation and industrial polution.
- CoE recognizes it's responsibility to provide a healthy and safe environment as mandated by the following legislation:
  - Section 24 of the Constitution of South Africa 1996
  - Section 28(1) of National Environmental Management (Act No 104 of 1998)
  - Section 19 of National Water Act (Act 36 of 1998)
- CoE initiated several Catchment Master Plan studies to produce remediation interventions & related environmental authorisations.

Discussing Elsburgspruit & Blesbok Catchment Remediation Plans

FOR:

CITY OF EKURHULENI

City of Ekurhuleni

BY:

NEWTOWN LANDSCAPE ARCHITECTS CONSORTIUM

NLA

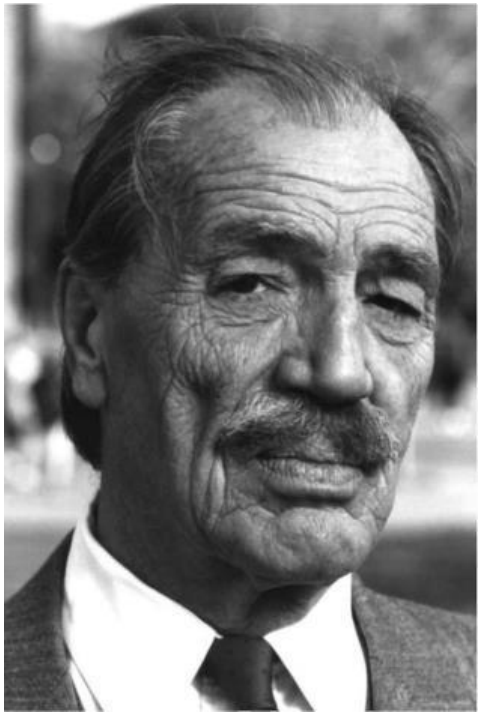
delta h
WATER SYSTEMS MODELLING

GANT
PROJECT MANAGEMENT (PTY) Ltd.
CONSULTING ENGINEERING
BUILT ENVIRONMENT PROFESSIONALS

GALAGO ENVIRONMENTAL
Biodiversity & Aquatic Specialists
Vat no: 4080227657
638 Turf Street
Wingate Park, 0180
Tel: 012-345 4891
Fax: 086 675 6136
Cell: 082 322 5688
vanessam@lantic.net
www.galagoenvironmental.co.za

The **Sustainable Urban Drainage Systems (SUDS)** is based on the understanding that **land is a crucial component of the built environment** and can be planned, **designed**, developed, and maintained to **avoid, mitigate, and even reverse detrimental impacts**.

‘Sustainable Urban Drainage Systems (SUDS)’ (Sometimes called **‘low Impact Development', LID**) can thus be defined as to mimic the **pre-development situation** both with regard to **runoff quality, runoff quantity, amenity** and **biodiversity**

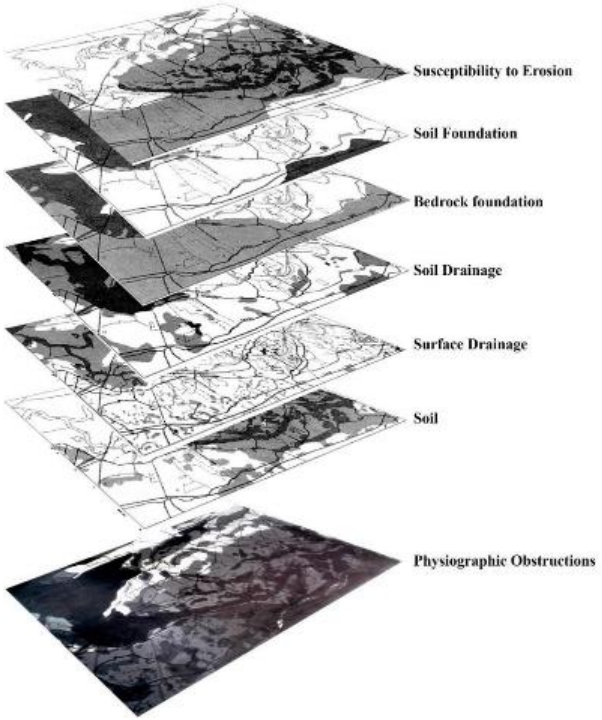



DESIGN
WITH NATURE
IAN L. McHARG
DESIGN WITH NATURE
IAN L. MCHARG
25th
anniversary
edition

Ian McHarg

Design with Nature (1969)

- Replace the **polluted, bulldozed, machine dominated, dehumanized, explosion-threatened** world that is even now disintegrating and disappearing.
- In presenting us with a vision of **ecological** design promise to revives the hope for a better city.
- "Without the **passion** and **courage** and **confident skill** of people like McHarg that hope might fade and disappear forever" – Lewis Mumford



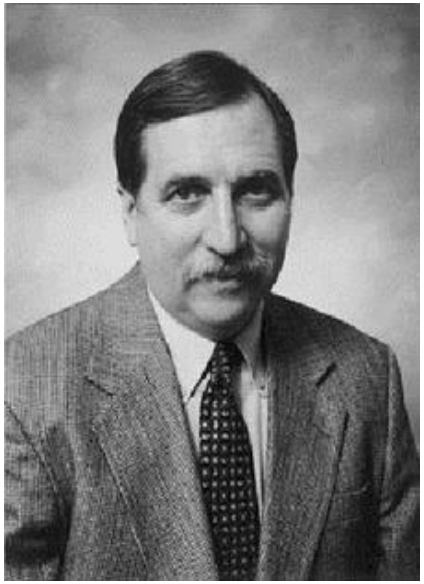
Ian McHarg

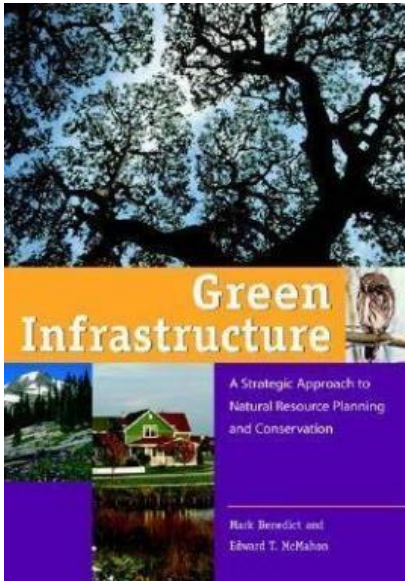
“We need to recognize **nature** as "an **essential force** that **permeates** the **city**."

By **embracing** the **presence of nature's processes** within the **city**, we can create an **ecological urbanism** that combines **human** and **natural systems** for the betterment of both”. (Spirn).

"The realization that **nature** is **ubiquitous**, a **whole** that **embraces the city**, has powerful implications for how the city is **built** and **maintained** and for the **health, safety, and welfare of every resident**" (Spirn).

Anne Whiston Spirn - The Granite Garden





E. McMahon, M. Benedict - Green Infrastructure

- ***Green Infrastructure*** : "***Linking Landscapes and communities"*** and "***A strategic approach to natural resource planning and conservation" (2006).***

- Explains the need to implement **sensible**, **sustainable land use plans** in the cities, towns, communities, and neighbourhoods in which we live.

E. McMahon, M. Benedict - Green Infrastructure

Study area

Google Earth Image - 03/2019

Proposed Elsburgspruit Project Site

Figure 1: LOCALITY MAP - Elsburgspruit Remediation Project

June 2019

Approach

- The remediation plan was eniciated by conducting various specialist studies:
  - Present & Future Land use study
  - Aquatic & Biodiversity assessment
  - Hydrological assessment
  - Review of Floodline & drainage patterns.

- This data was reviewed from an **Ecological, Engineering and Landscape** architecture perspective

- Team developed a list of **potential remediation interventions,** which was a specific Client requirement

- To secure the future management and maintenance of the priority intervention, we aimed to couple them with **opportunities for parks and recreational developments** like educational centers, sport fields, conservation areas and urban agriculture.

- A **Landscape Master plan** was developed which formed the context for the Environmental and Water Use applications

Land Use Assessment

- Anthropogenic impacts have occurred over last 130 years
- Establishment & growth of gold mines and residue tailings and their continued impact the environment
- Current threats of Acid mine drainage (AMD) is severe and continued efforts from TCTA has reduced this threat
- Development and expansion of industrial areas around the mines.
- Growth of Residential areas with marginalized township expanding into buffer areas and floodline

Aquatic Assessment

- Sampling for biotic factors according to SASS5 at set sampling points along the system.

- Fish sampling
    - No fish in system

- Water quality parameters tested within the Catchment:
    - Parts Per Million (PPM) and Conductivity (266 -1909)
    - pH (7.3-8.4)
    - Total coliforms (0-100 000)

- Community is aware of state of pollution and advised specialist to stay out of water

	Abiotic factors						Composition	
Intervention location no	System condition			Str			Structure	Substance
	System conditions comprise the structures and processes related to climate (temperature, rainfall), geology and geomorphology (like slope, soil composition conditions functioning at a space (the catc (±100 year conditions ar m					ce to mouth/) (level 2/3)	Morphological features of the aquatic ecosystems- stream bottom, beds and banks.	Nutrients, organic matter, oxygen, major ions and contaminants. From catchment boundary towards the stream the mount of dissolved substances increases. This increase is also visible from source to mouth.
	Climate	Ge						rocesses
1	0							
2	0							
3	0							
4	0							
5	0							
6	0							
7	0							
8	0							
9	0							
10	0							
11	0							
12	0							

Biotic			
Species			
Present ecological score where Mean of all systems is D. A=+10, B=+8, C=+4, D=0, E=-5, F=-10	Invertebrata	Ithcyofauna	Ecological integrity scor A=+10, B=+8, C=+4, D=0, E=-5, F=-10
PES	SASS ASPT rating	Fish population rating	EIS
0	-10	0	-4
4	4	0	4
-3	-8	0	2
0	0	0	0
0		0	2
-3		0	2
4		0	2
4	5	0	2
0	0	0	0
0	0	0	0
4		0	2
0	0	0	2

Imp					
Magnitude	Scale	Co (D	se of vention llation	Contribution to catchment	Impact assessment sub average
10= Very high, 8= High, 6= Moderate, 4= Low, 2= Minor, 0= Status quo	10= Whole catchment, 6= Reach of drainage, 3= Section of drainage, 0= Only location	p	ficult -10 y 10	Effect if implemented	
10	6		10	10	2,2
8	3		-5	5	3,2
10	10		-5	10	6
0	0		0	0	0
6	6		-5	5	1,4
10	6	5	-8	8	4,2
8	6	5	10	5	6,8
6	6	-5	0	8	3
4	3	5	-7	5	2
4	4	0	-5	6	1,8
8	6	5	10	5	6,8
6	5	5	8	5	5,8

Abiotic Sub average
-5,5
-0,7
-0,7
-1,6
-2,9
-2,6
0,2
-1,9
-2,4
-3,4
-1,6
-0,9

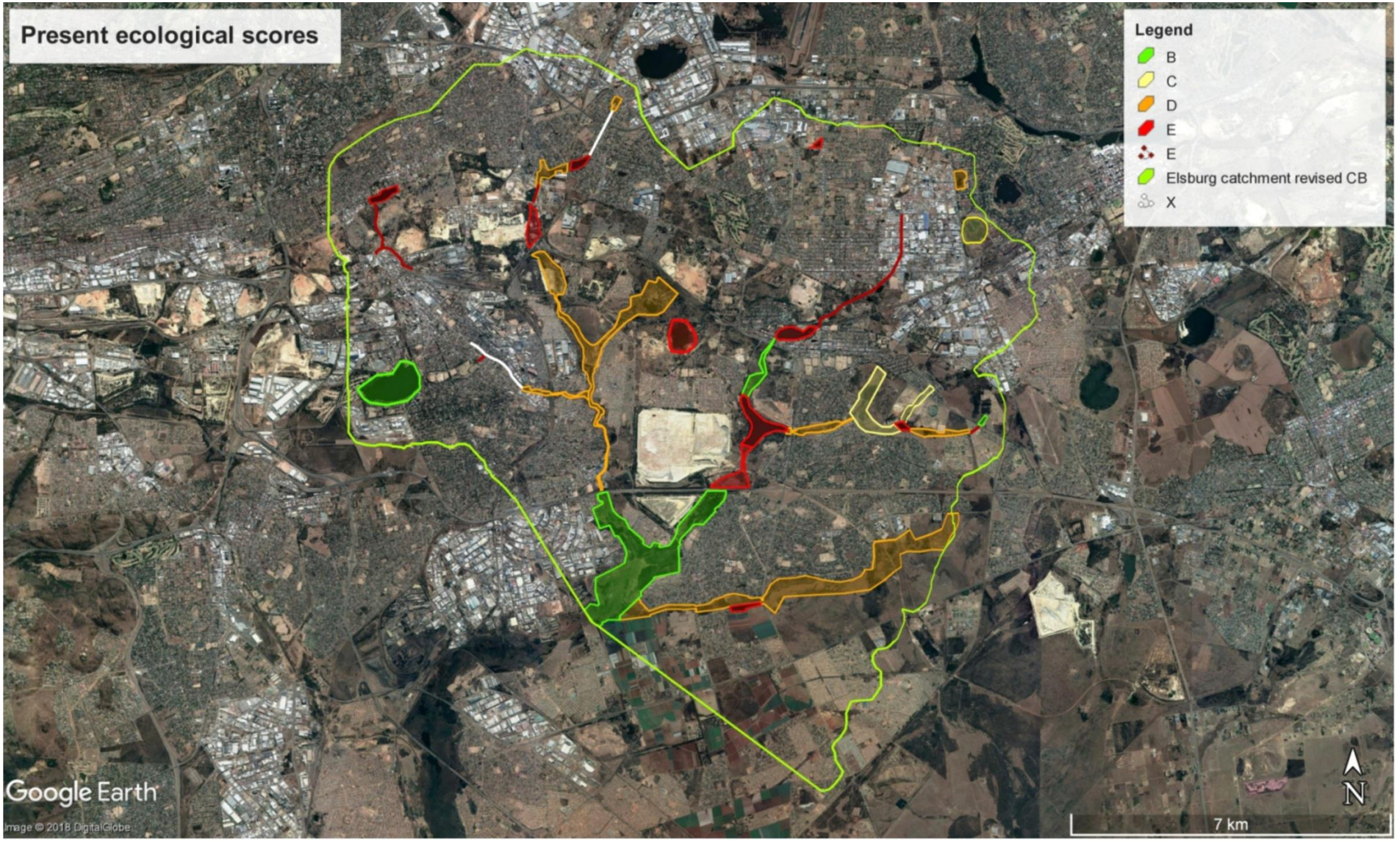
Mean
-6,8
4,2
3,6
-1,6
-2,1
-0,2
7,6
4,3
-1,7
-2,9
5,8
4,4

Ra
quo of catchmer
as catchment. R

- Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) calculated.

- Most of the aquatic ecosystems of the study site scored a PES of D or lower, 7 out of 32 aquatic ecosystems had a PES above D.

DESCRIPTION	IMPACT SCORE RANGE	HEALTH CATEGORY
Unmodified/ natural	0-0.9	A
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2-3.9	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E
Modifications have reached a critical level and the ecosystem processes have been modifiedcompletely with an almost complete loss of natural habitat and biota.	8 – 10	F



Elsburgspruit Present Ecological Scores

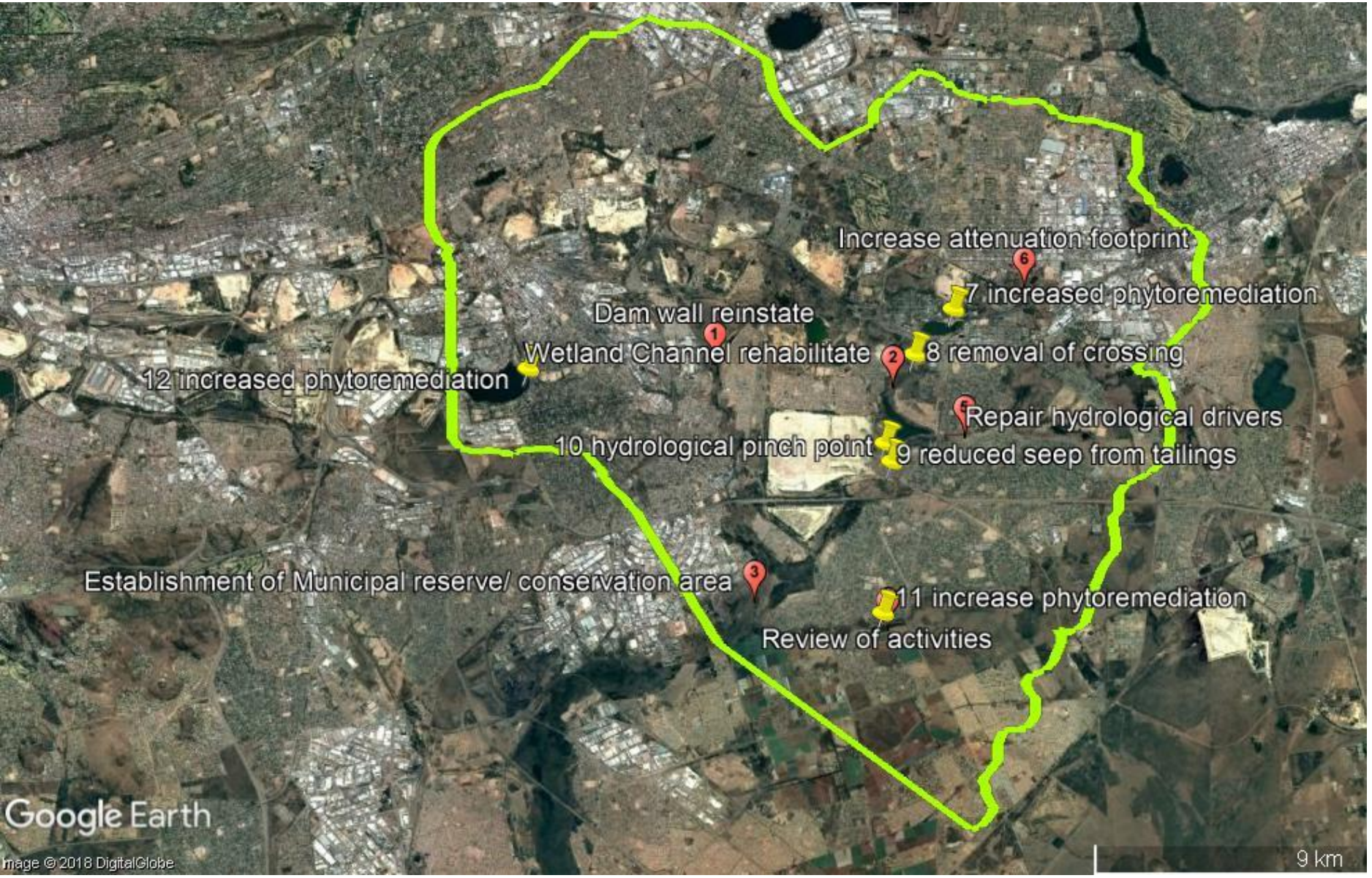
Elsburgspruit Ecological Importance Scores

List of Interventions for Elsburgspruit

- *Intervention 1: Reinstatement of the dam wall at Reiger Park*
- Intervention 2: Wetland Chanel Rehabilitation
- Intervention 3: Establish Municipal Reserve Area
- *Intervention 4: Phytoremediation of an agricultural dam.*
- Intervention 5: Repair hydrological drivers
- Intervention 6: Increase attenuation footprint
- Intervention 7: Boksburg Lake: Increase phytoremediation by introduction of floating wetlands
- Intervention 8: Removal of crossing
- *Intervention 9: Reduce seep from tailings facilities*
- Intervention 10: Remove hydrological pinch point - old structures and their abutments should be demolished.
- Intervention 11: Germiston / Victoria Lakes Increase phytoremediation by the introduction of floating wetlands

Interventions

- Key interventions were developed to facilitate *catchment scale* changes.
- Smaller interventions are proposed, based on available budget, but still have an impact on the overall PES condition of the catchment.
- Goal: Catchment is to increase the PES from an average of “D” or “C” average
- Objectives:
  - **Ensure that the aquatic ecosystem functioning is improved**
  - **Restore the natural vegetation of the impacted areas,**
  - **Use structures to have an improvement on condition of system**
- Study identified 11 key interventions required within the Elsburgspruit Catchment as well as a number of generic interventions
- Of the 11 interventions, 3 were not investigated further due to financial constraints or legality of ownership

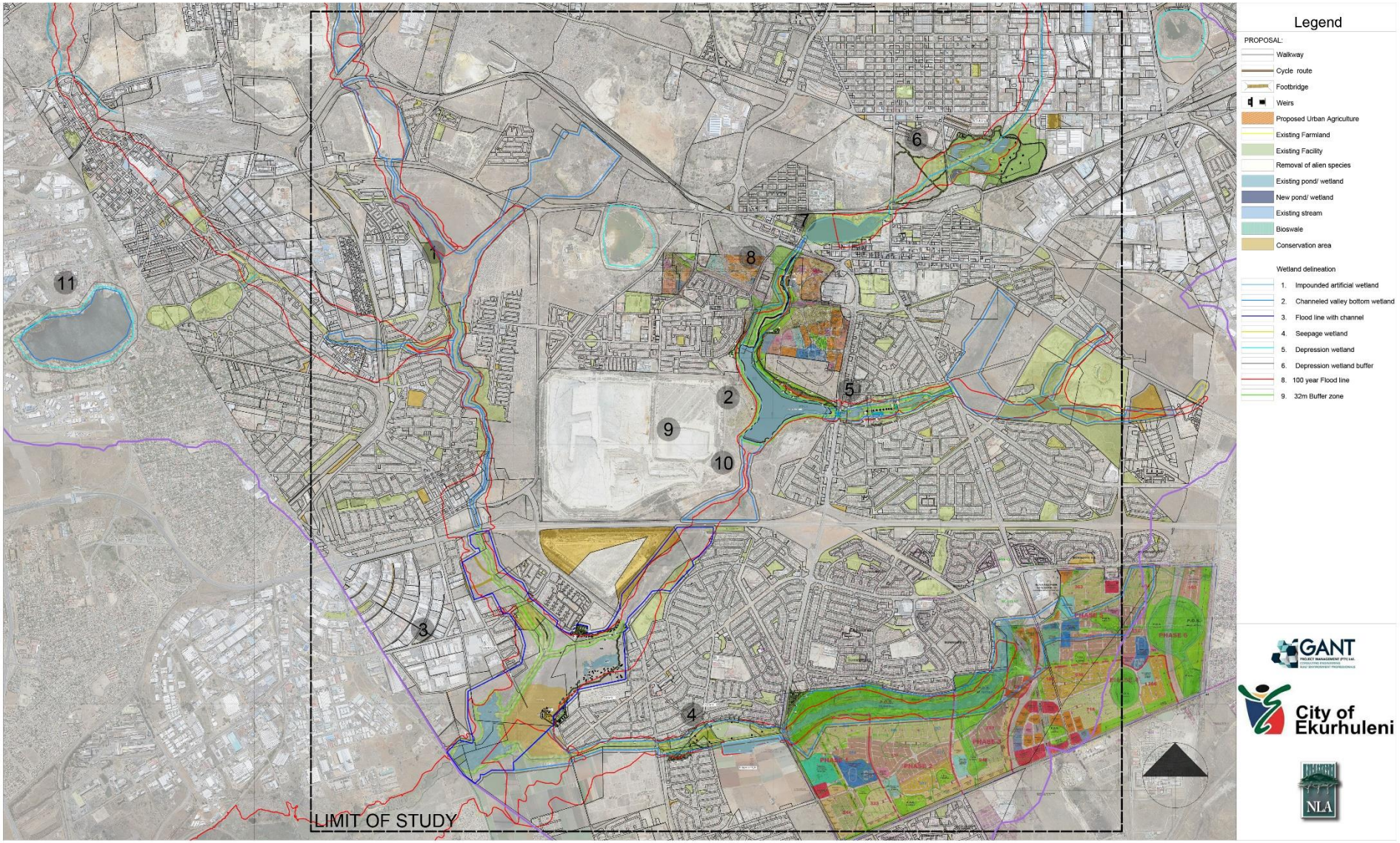

Increase attenuation footprint
6
7 increased phytoremediation
Dam wall reinstate
1
Wetland Channel rehabilitate
2
8 removal of crossing
12 increased phytoremediation
5
Repair hydrological drivers
10 hydrological pinch point
9 reduced seep from tailings
Establishment of Municipal reserve/ conservation area
3
11 increase phytoremediation
Review of activities
Google Earth
Image © 2018 DigitalGlobe
9 km


Elsburg rehab
Legend
Elsburg catchment smaller Wadeville
Google Earth
Image © 2018 DigitalGlobe
N
900 m


Elsburgspruit Intervention

Generic Interventions

- Establishment of Catchment Management Committee
- Addressing sewer spillages/blocking of sewers
- Inefficient functioning of from ERWAT treatment plants
- Removal of litter from wetlands
- Improving the way storm water reaches wetland/river system
- Removal of alien an invasive species
- Providing formal pedestrian crossings
- Installing of Weirs/ Steps to slow stream flow
- Providing formal open space / beatification
- Developing catchment monitoring plans



Composite Plan

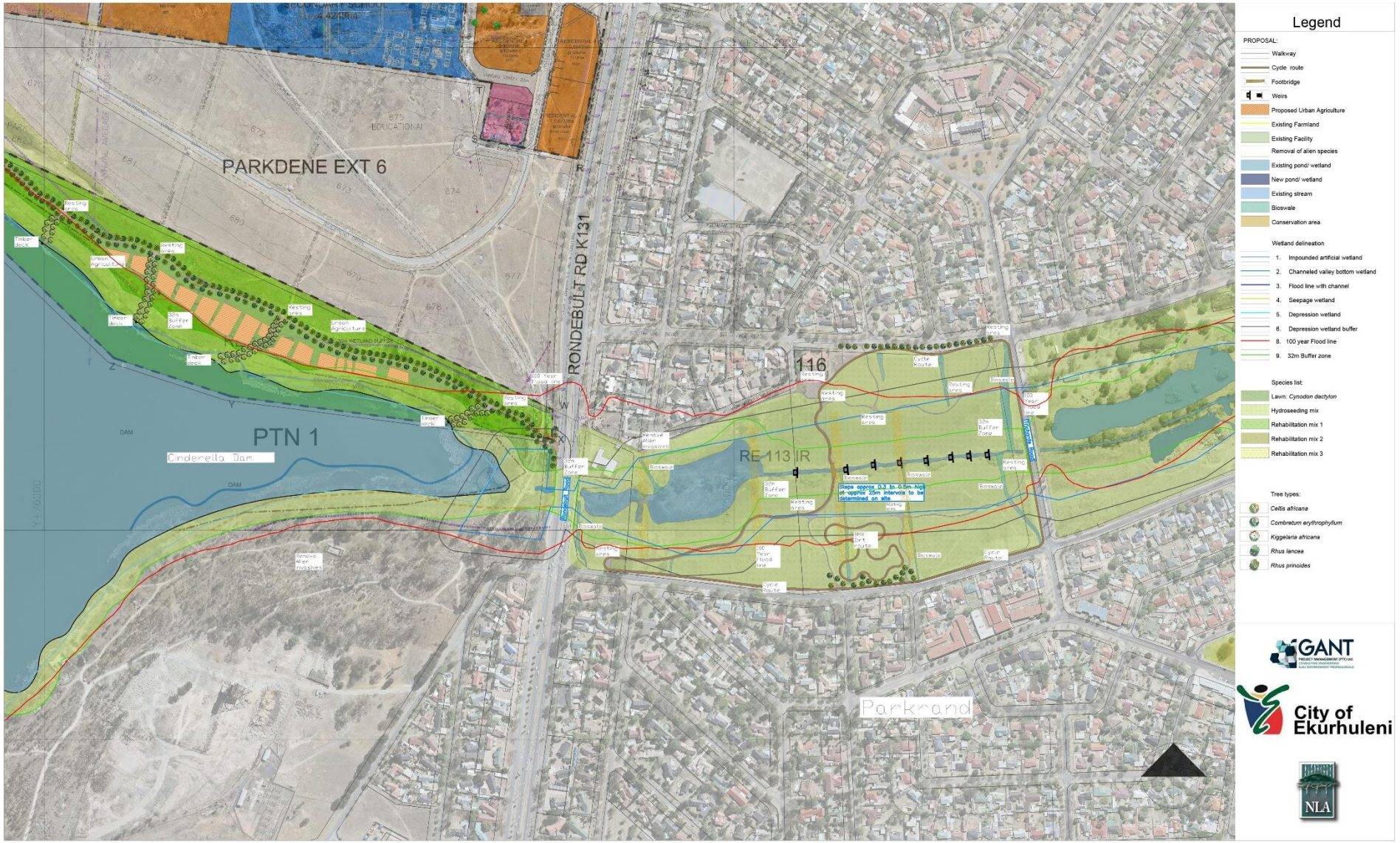
Scale 1:40 000 on A3

Intervention 2: Wetland Channel Rehabilitation- Parkdene/ Reiger Park

Scale 1:5000 on A3

Intervention 3: Establish municipal reserve area- Elspark

Scale 1:5000 on A3



Intervention 5: Repair Hydrological drivers- Parkrand

Scale 1:5000 on A3

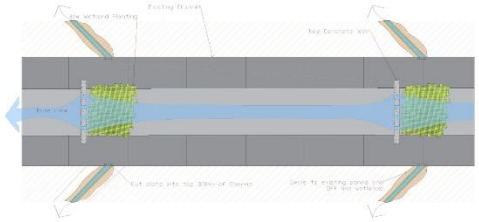
Legend

PROPOSAL:
- Walkway
- Cycle route
- Footbridge
- Weirs
- Proposed Urban Agriculture
- Existing Farmland
- Existing Facility
- Removal of alien species
- Existing pond/ wetland
- New pond/ wetland
- Existing stream
- Bioswale
- Conservation area

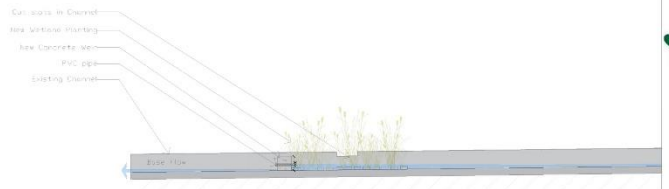
Wetland delineation
1. Impounded artificial wetland
2. Channeled valley bottom wetland
3. Flood line with channel
4. Seepage wetland
5. Depression wetland
6. Depression wetland buffer
8. 100 year Flood line
9. 32m Buffer zone

Species list:
- Lawn: *Cynodon dactylon*
- Hydroseeding mix
- Rehabilitation mix 1
- Rehabilitation mix 2
- Rehabilitation mix 3

Tree types:
- *Acacia caffra*
- *Buddlea saligna*
- *Celtis africana*
- *Combretum erythrophyllum*
- *Kiggelaria africana*
- *Leucosidea sericea*
- *Vachellia xantophloea*



Plan scale 1:250



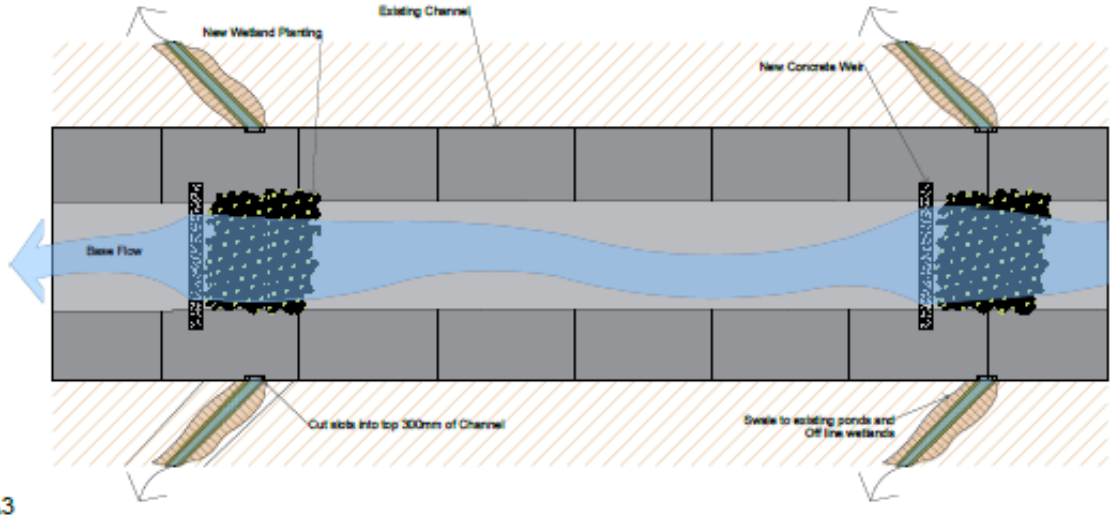
Section scale 1:100

City of Ekurhuleni

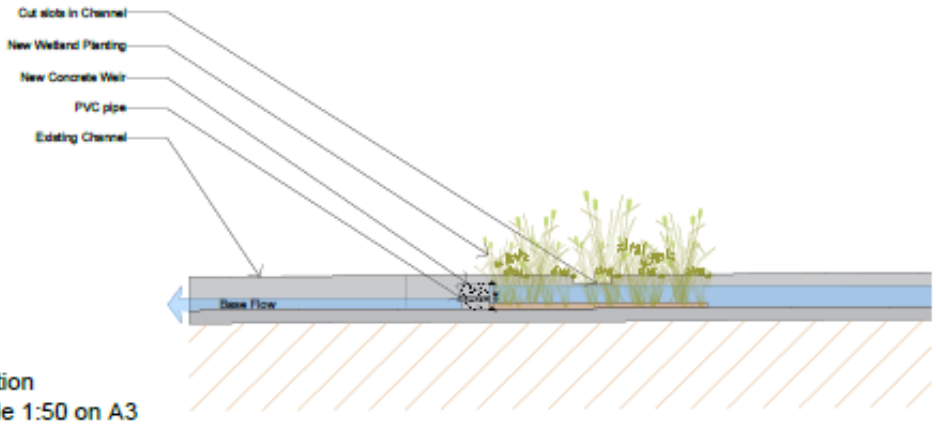
NLA

Intervention 6: Increase attenuation footprint- Boksburg

Scale 1:5000 on A3



Plan view
Scale 1:100 on A3



Section
Scale 1:50 on A3

Legend

GANT

City of Ekurhuleni

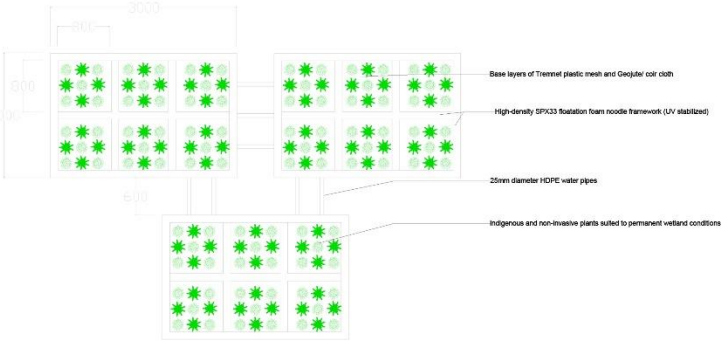
NLA

Intervention 6: Upstream channel weir detail- Boksburg

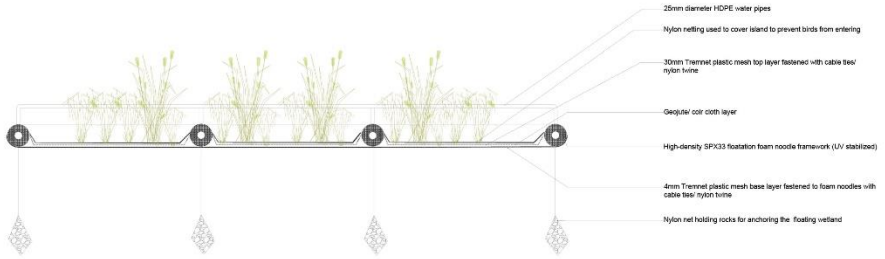
Legend

PROPOSAL:

- Floating wetland
- Existing Facility
- Existing pond
- 100 year Flood line
- 32m Buffer zone



Plan
Scale 1:75 on A3



Section
Scale 1:25 on A3

Intervention 7: Floating Wetlands

Scale 1:5000 on A3

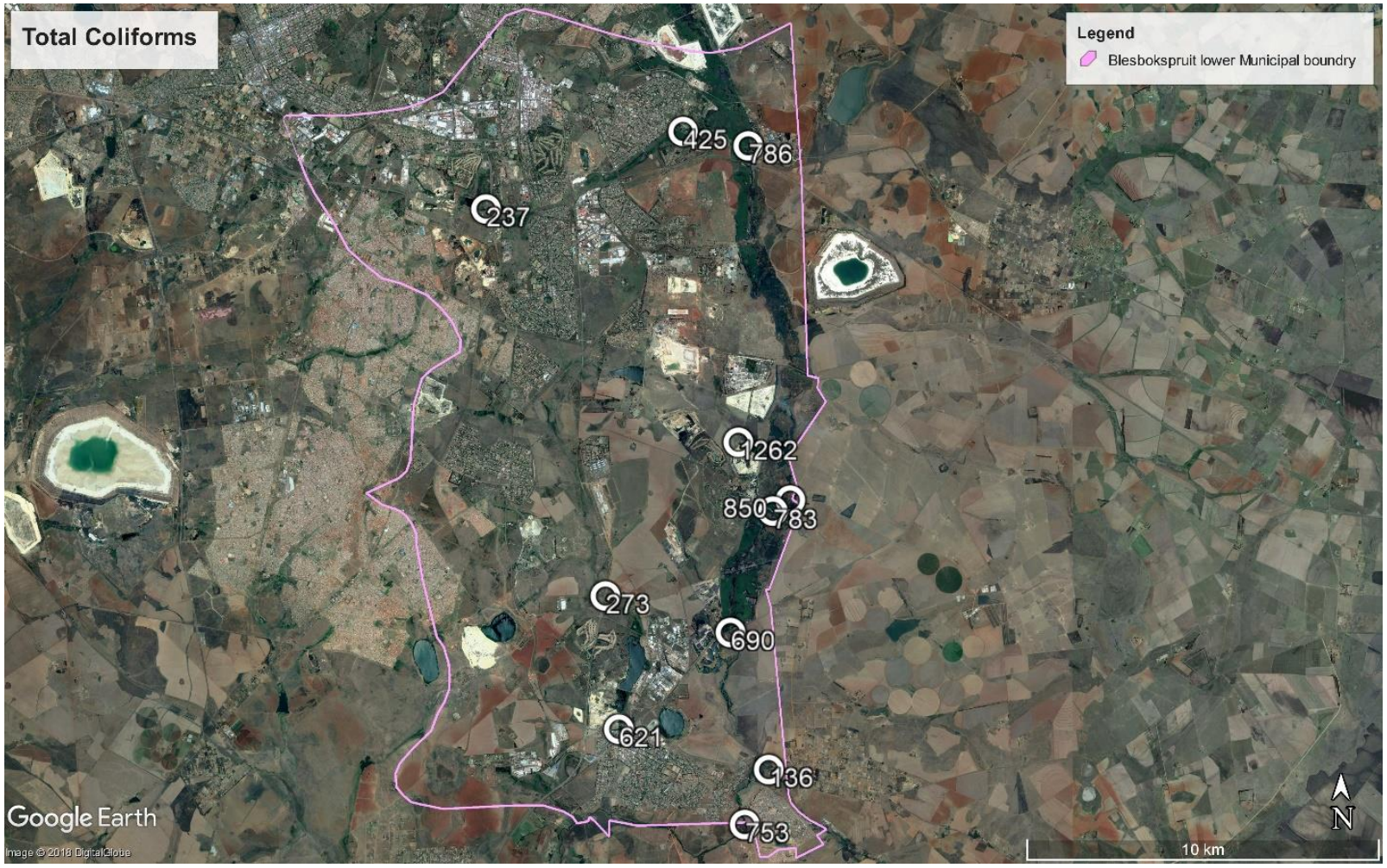
Blesbokspruit Catchment

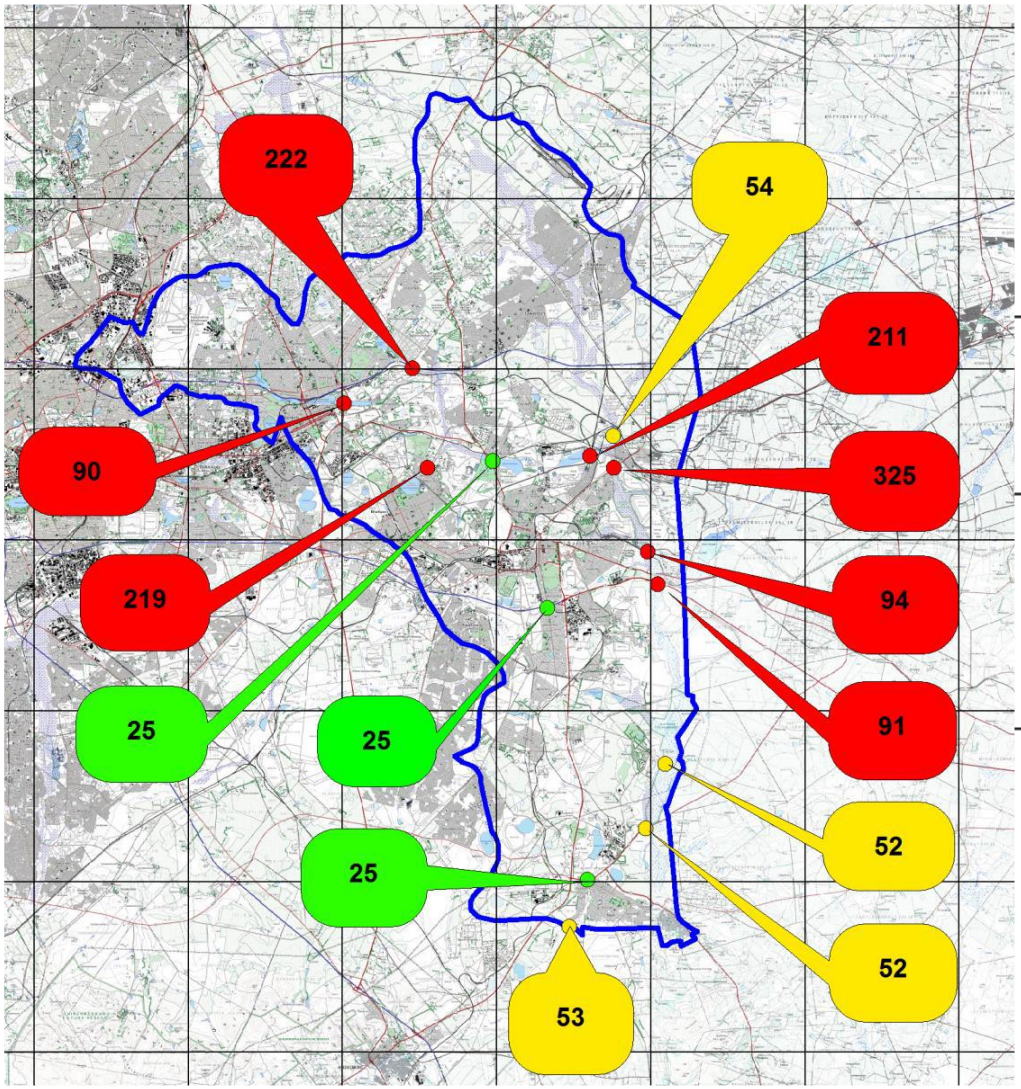
- Blesbokspruit was on the RAMSAR list and currently (2019) on the Montreux record.

- Value of wetland demonstrated by water quality parameters results

- Major impacts:
    - Crossings (Formal & Informal Roads, Railway)
    - Sewer spills
    - Illegal mining activities
    - Encroachment into buffer and wetland
    - AMD

Blesbokspruit Total Coliforms

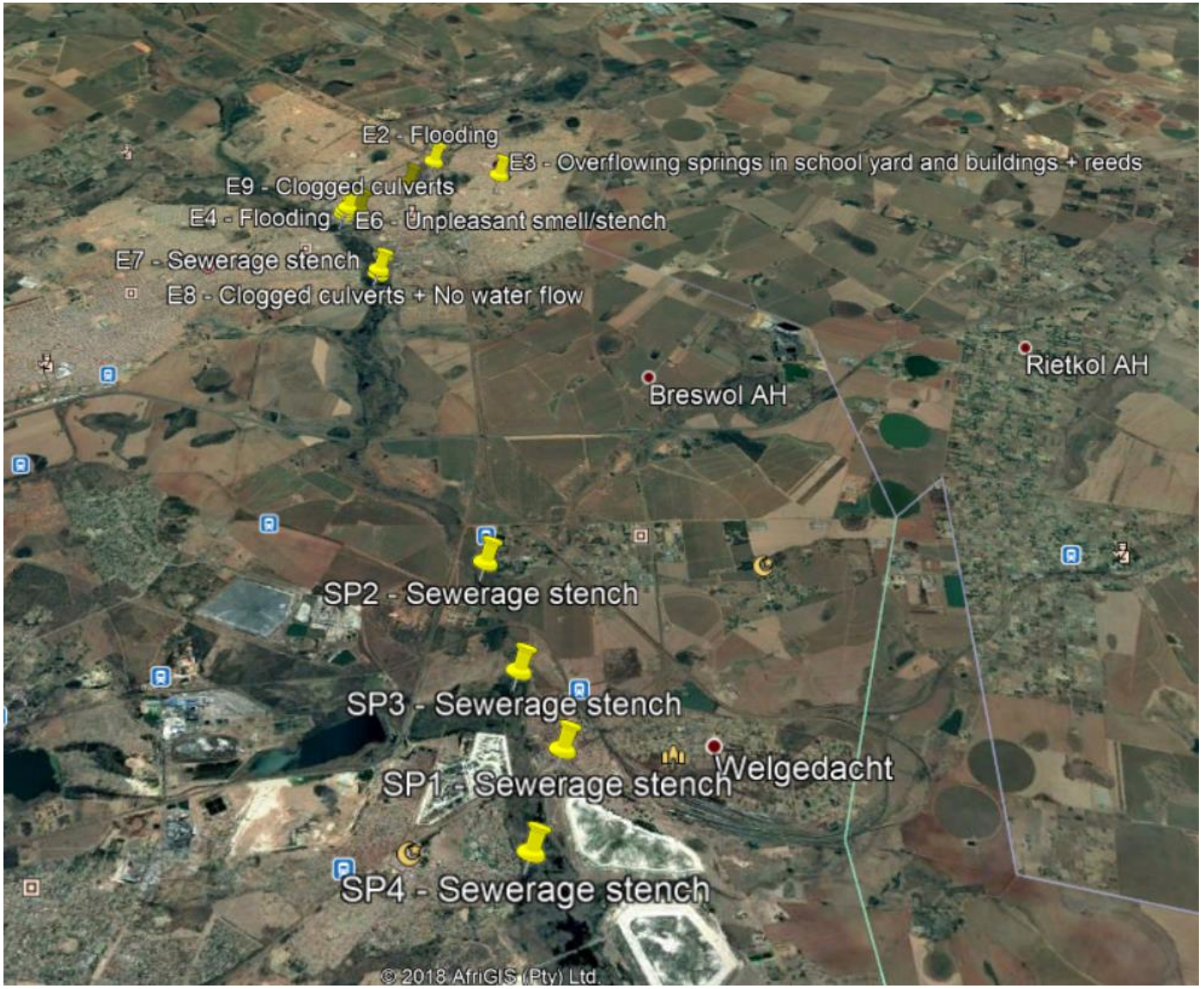




Oligotrophic conditions; usually moderate levels of species diversity; usually low productivity systems with rapid nutrient cycling; no nuisance growth of aquatic plants or blue-green algae.
Mesotrophic conditions; usually high levels of species diversity; usually productive systems; nuisance growth of aquatic plants and blooms of blue-green algae; algal blooms seldom toxic.
Eutrophic conditions; usually low levels of species diversity; usually highly productive systems, with nuisance growth of aquatic plants and blooms of blue green algae; algal blooms may include species which are toxic to man, livestock and wildlife.
Hypertrophic conditions; usually very low levels of species diversity; usually very highly productive systems; nuisance growth of aquatic plants and blooms of blue-green algae, often including species which are toxic to man, livestock and wildlife.

Blesbok Spruit – Phosphates

Upper Blesbokspruit Problem Sites: Google Earth Placemarks



Upper Blesbokspruit Problem Sites: E1 Erosion on downstream side of culverts + flooding








Upper Blesbokspruit Problem Sites: E3 Overflowing springs in school yard, classrooms + reeds

Upper Blesbokspruit Problem Sites: E5 Flooding, illegal dumping + clogged SW outlet


Lupin Ave
Main St
James St
School St
Henry St
Evans St
Welgedacht Rd
Slovo Park
Slovo Park
Blossom Rd
Honeysuckle Dr
Tac Rd
Bakerton
2nd St
3rd St
1st Rd
Plumbago Rd
Francolin Dr

Legend

INTERVENTION 01 LEGEND:

- 0.6m Wide x 1m deep French Drain
- 300mm Dia. Pipe
- Sump
- 100 Year Floodline

Intervention No. 1 - R42 Road

Scale on A3: 0 20 50 100 150 200 m

Lesson learned

- Interdepartmental interaction, input and commitment is essential
- Public Participation allows communities to understand the scientific issues and to provide input, BUT it also exposes a lot which is not been done by Municipalities
- Public do have some unrealistic expectations
- Consultative planning process help with environmental education and protection of buffers and wetlands
- Smaller interventions could have large scale impacts
- A range of interventions allow for smaller and larger projects to follow, based on available budget
- Master Plan provide bases to decisions and propoer management

“Clearly the problem of man and nature is not one of providing a **decorative background** for **human play**, or even ameliorating the **grim city**: it is the necessity of **sustaining** nature as **source of life**, **milieu teacher**, **sanctum**, **challenge** and, most of all of **rediscovering** nature’s corollary of the **unknown** in **self**, the **source of meaning**.”

- IAN MCHARG, Design with Nature