

Innovations in urban water management

# *Keeping the ~~end~~ loop in mind*

Bernelle Verster

Water Maverick, Shit Stirrer

Future Water Research Institute

University of Cape Town

January 2018



UCT Summer School Course 1003  
WATER SENSITIVE CITIES: PROSPECTS FOR CAPE TOWN



[www.futurewater.uct.ac.za/  
uct-summer-school](http://www.futurewater.uct.ac.za/uct-summer-school)



[www.indiebio.co.za/resources](http://www.indiebio.co.za/resources)



# Talking points

## prelude

Introducing me: What do I do, and how did I get there?

How do we make this real?

A.

What I research

Toilets

Three concepts:

B.

1. Jouissance
2. Tame Is Not Sustainable
3. Inverse Infrastructures

\*

Toilets again!

D.

Conclusion?

Continuing the conversation

C.  
House Jouissance  
Zandvlei Estuary

Who am I?





“What do you do and how did you get there?”

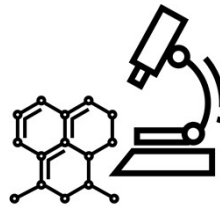
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2000-2004



**Fundamental science** “This is possible!”



Biochemist/Chemist

“What do you do and how did you get there?”

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2000-2004



GMO spider silk



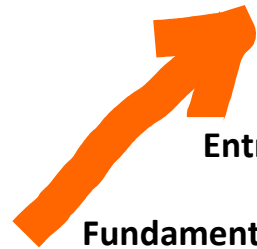
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2005-2006



**Entrepreneurship** “I could totally sell this”  
**Fundamental science** “This is possible!”



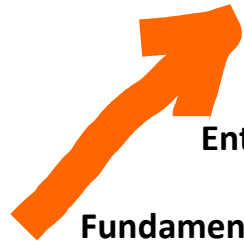
Biotech entrepreneur

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2005-2006



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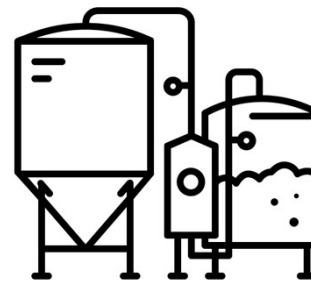
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2007 - present



Bioprocess engineer

**Engineering** “Uhm, I need to sell this cheaply enough”

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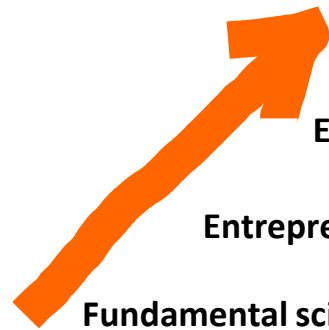
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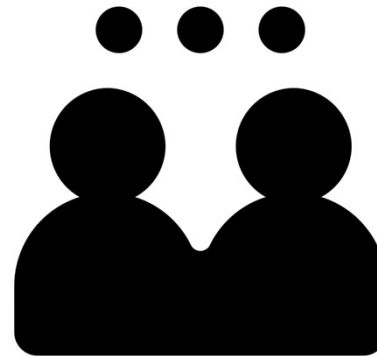
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2009-2011



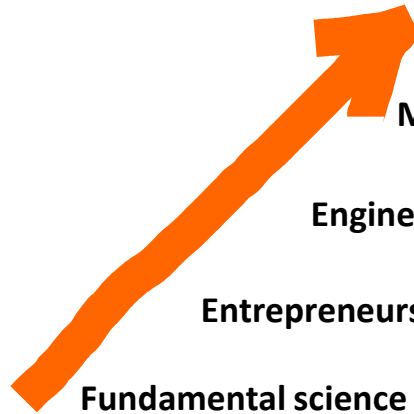
Communication

**Marketing** “People need to know that they need this!”

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“What do you do and how did you get there?”

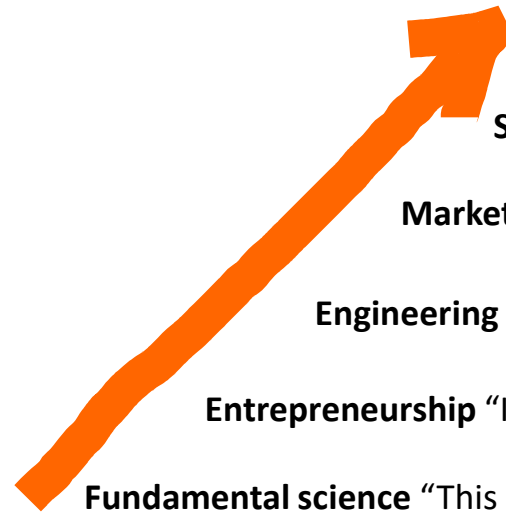


TEDx and Biomimicry and...

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2011 - 2012



**Systems** “People need to understand why they need this!”

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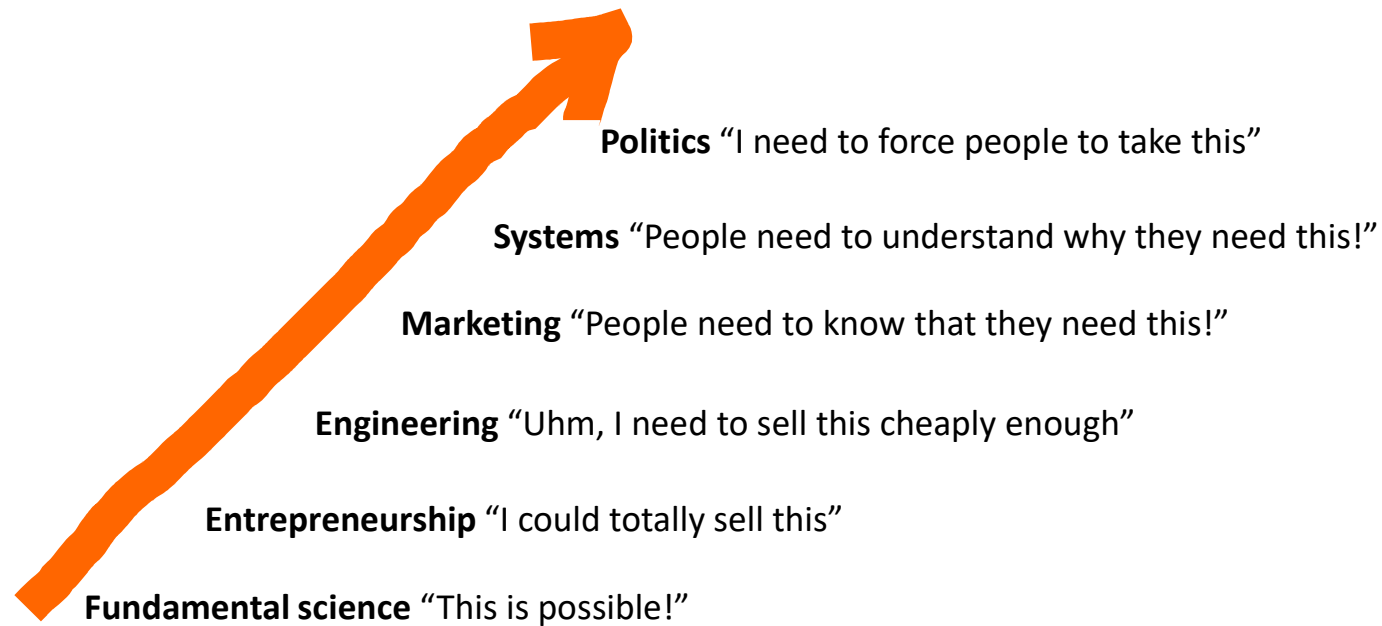


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2011 - 2012

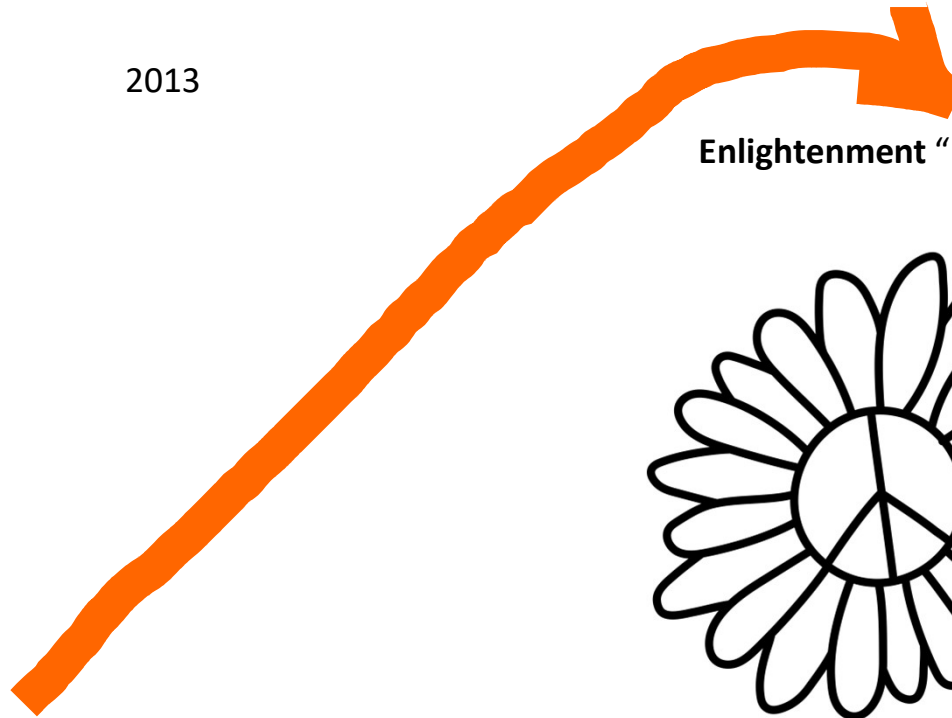


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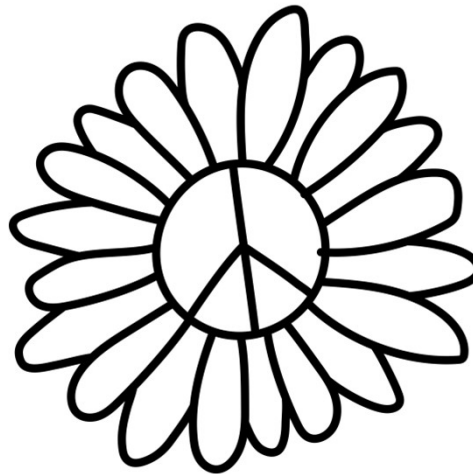
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2013



**Enlightenment “Fuckitall”**



“What do you do and how did you get there?”

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2013

**Enlightenment** “Fuckitall”



Koi pond building

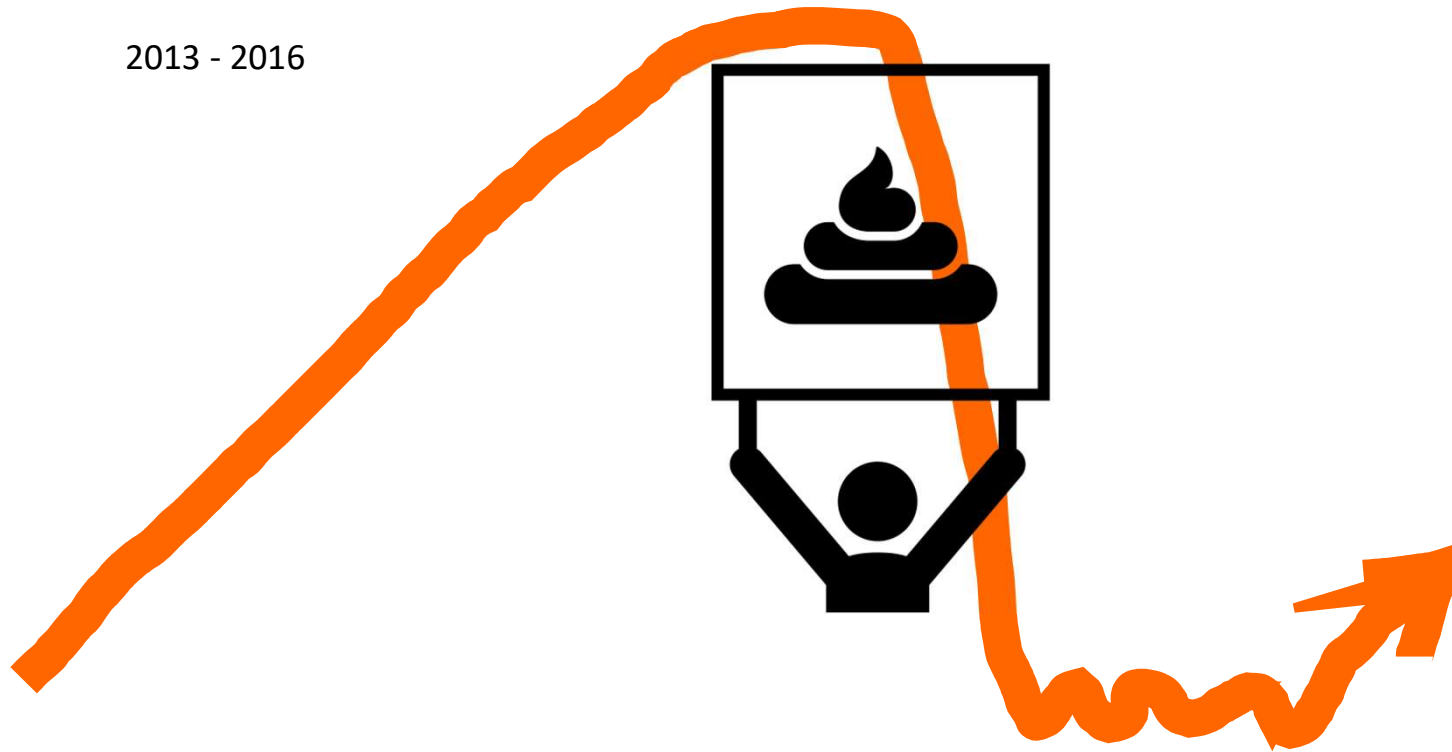


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2013 - 2016



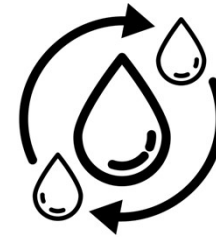
**Zombie apocalypse** “If/when it all goes  
pear-shaped, what do I need to know?”

“What do you do and how did you get there?”

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2013 - 2016



wastewater biorefineries



bacteria



algae



plants



fungi

**Zombie apocalypse** “If/when it all goes  
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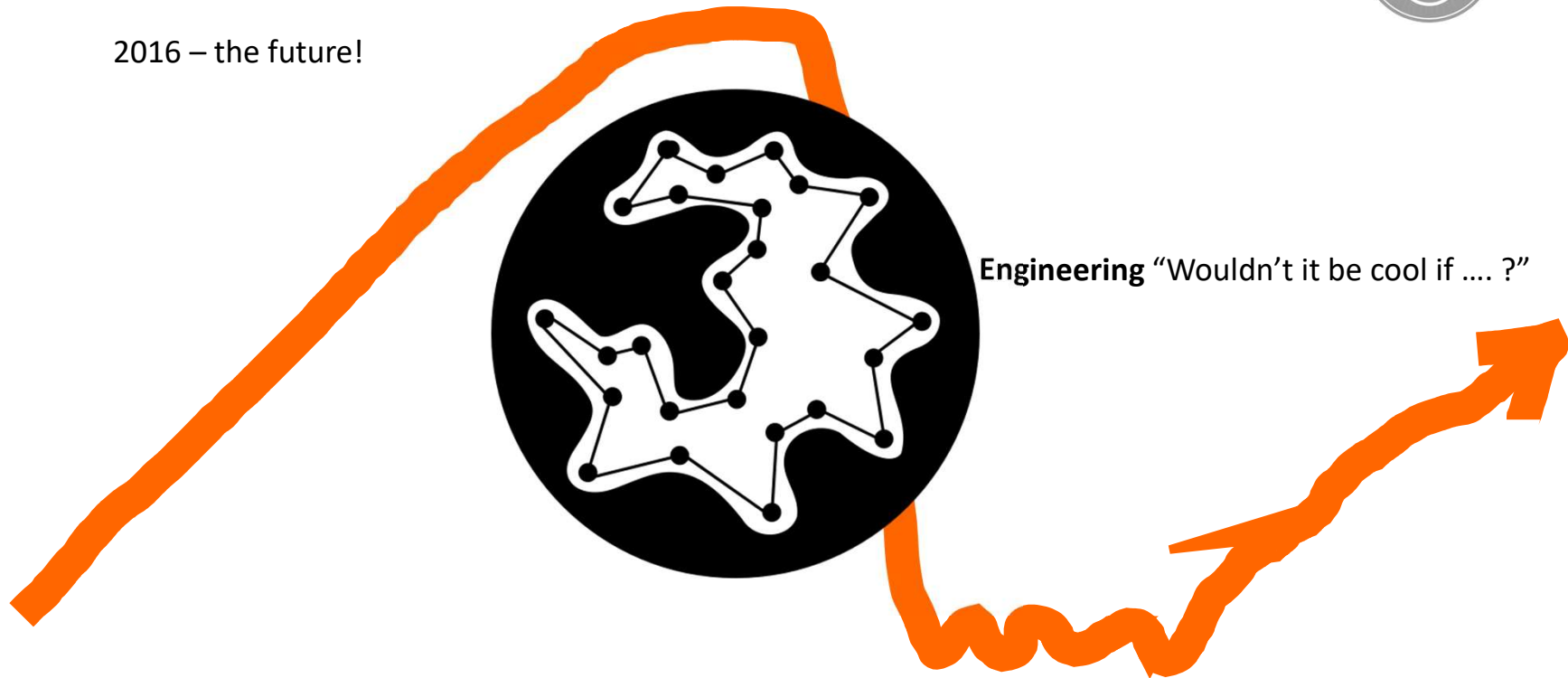
animals

“What do you do and how did you get there?”

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2016 – the future!



Engineering “Wouldn’t it be cool if .... ?”

"What do you do and how did you get there?"

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**Enlightenment** "Fuckitall"

**Politics** "I need to force people to take this"

**Systems** "People need to understand why they need this!"

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**Engineering** "Uhm, I need to sell this cheaply enough" **Engineering** "Wouldn't it be cool if .... ?"

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**Zombie apocalypse** "If/when it all goes pear-shaped, what do I need to know?"

<https://thenounproject.com>

Serendipity: building a house in the drought,  
lived in a shack without services for 2 years,  
overlooking the vlei







Questions from the previous days:

How do we make this real?

# TENSION

Transcendent third

Emerging middle

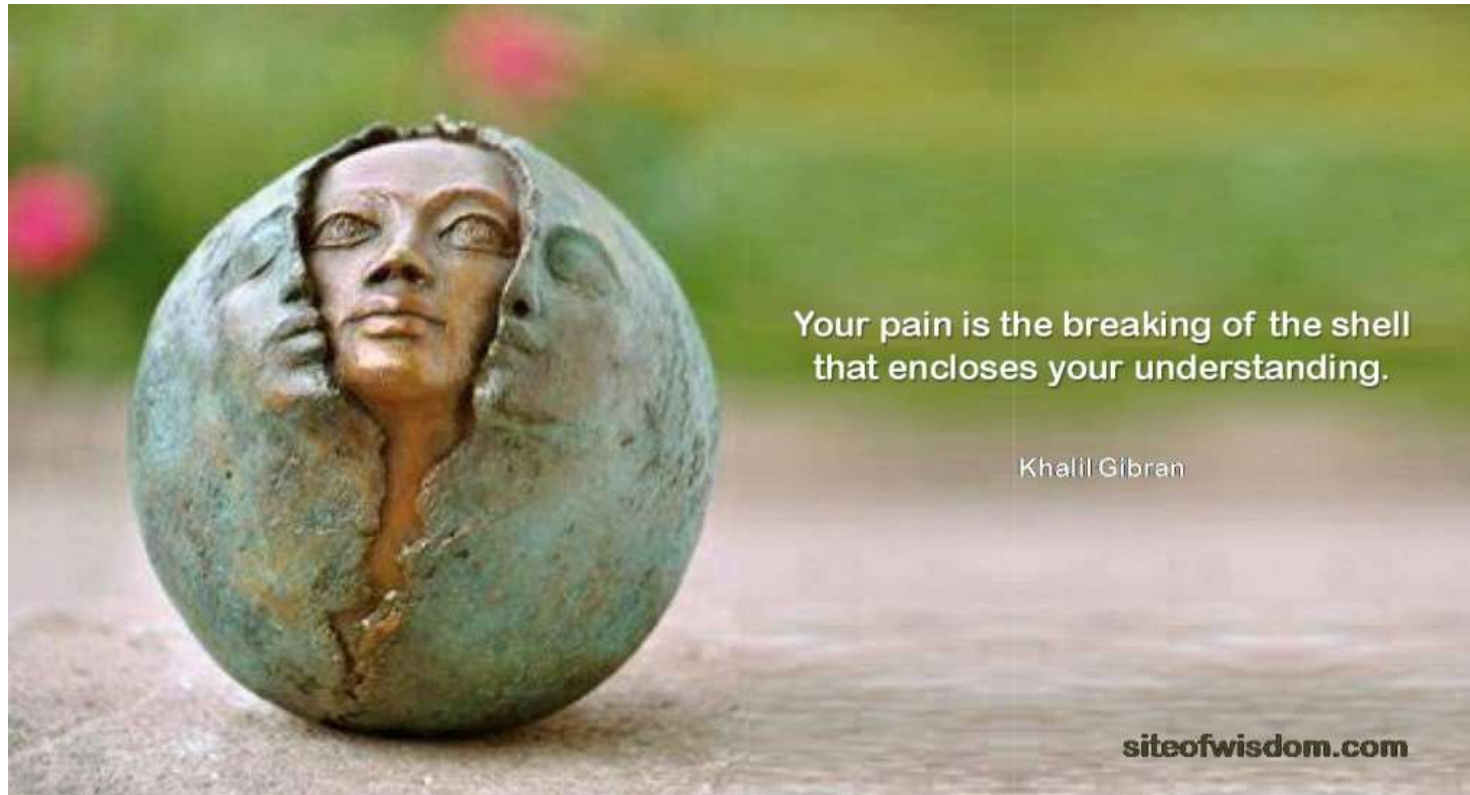
jouissance

Liminal:

occupying a position at, or on both sides of, a boundary or threshold

mestiza

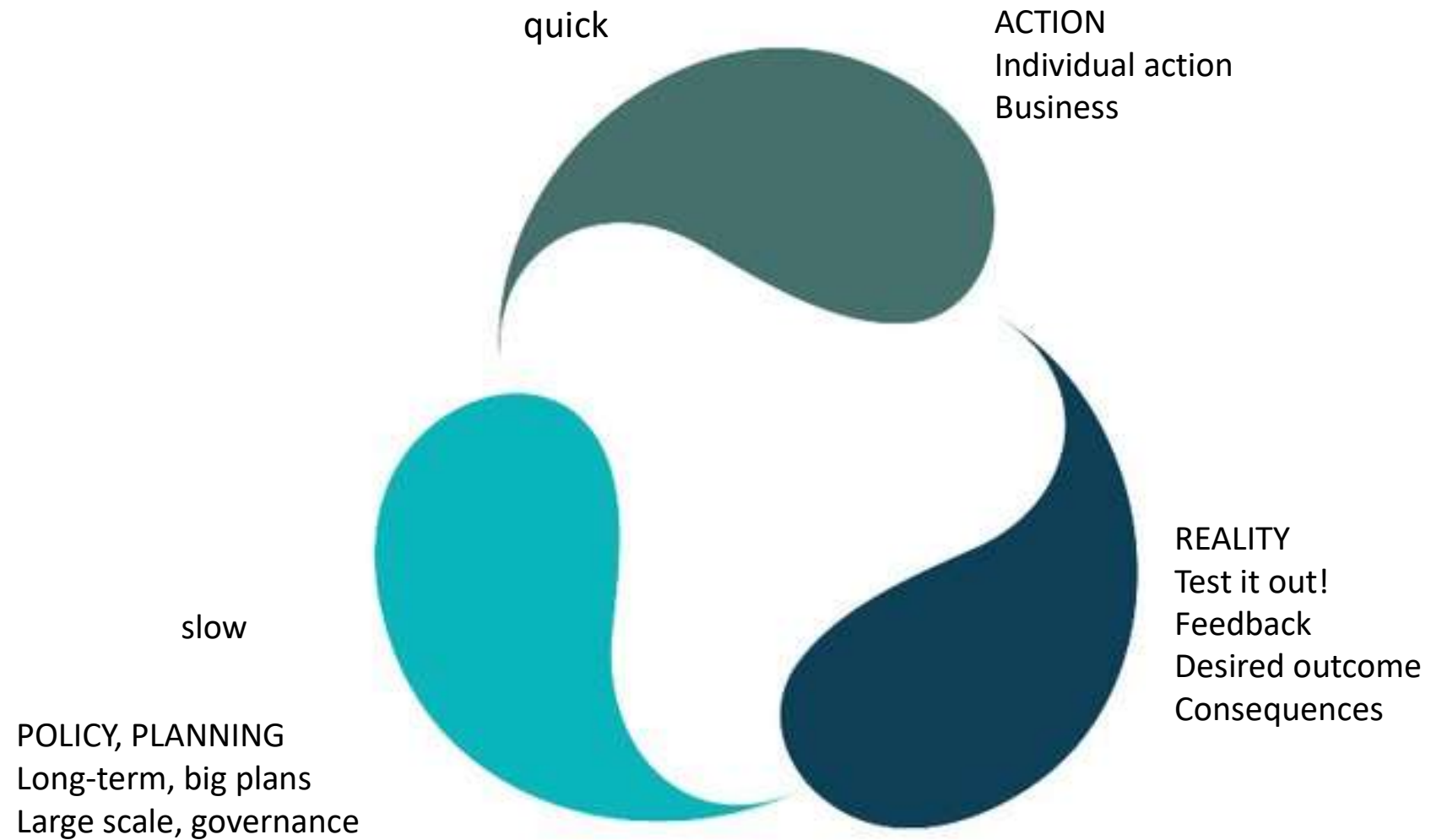
interfaces

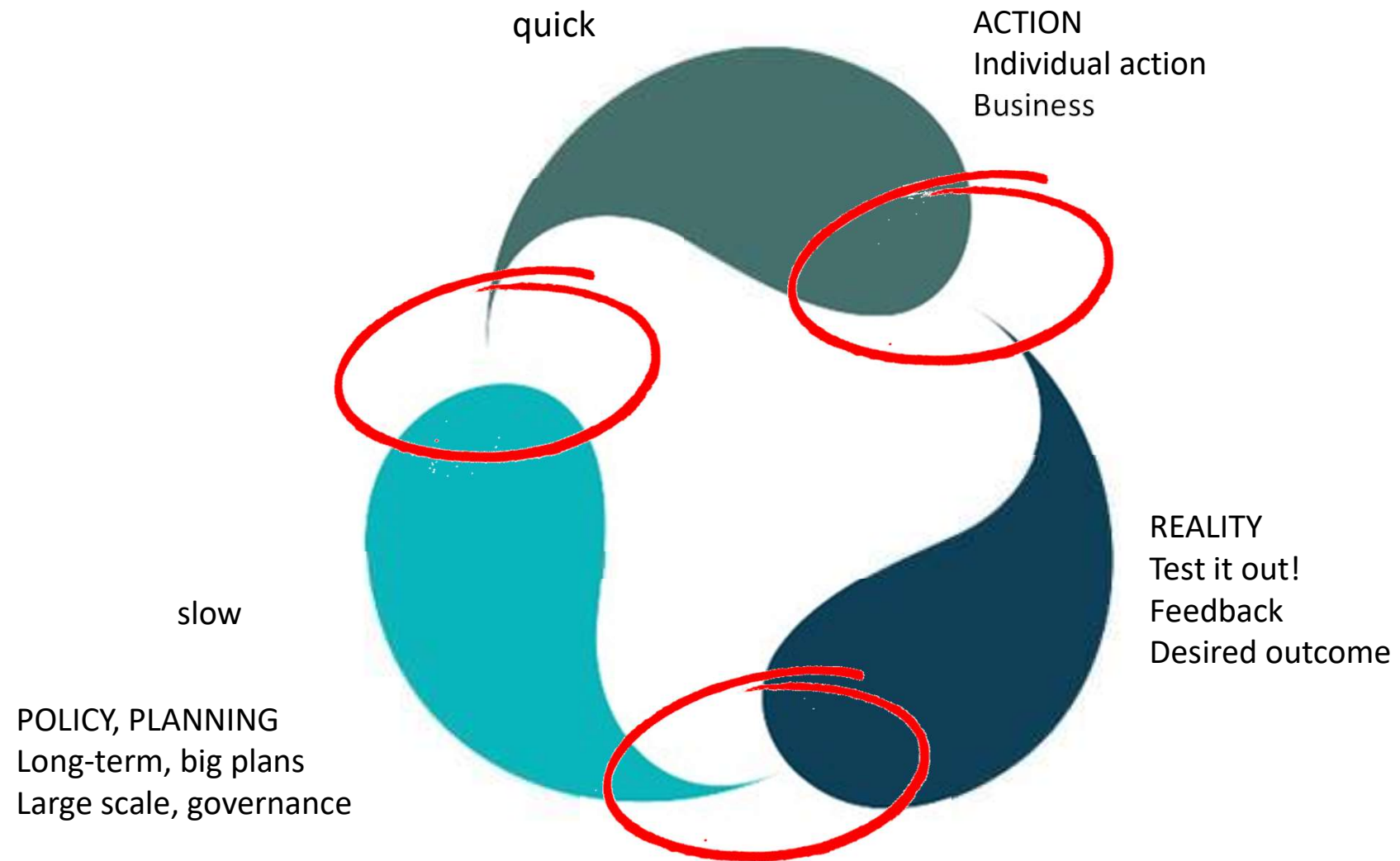


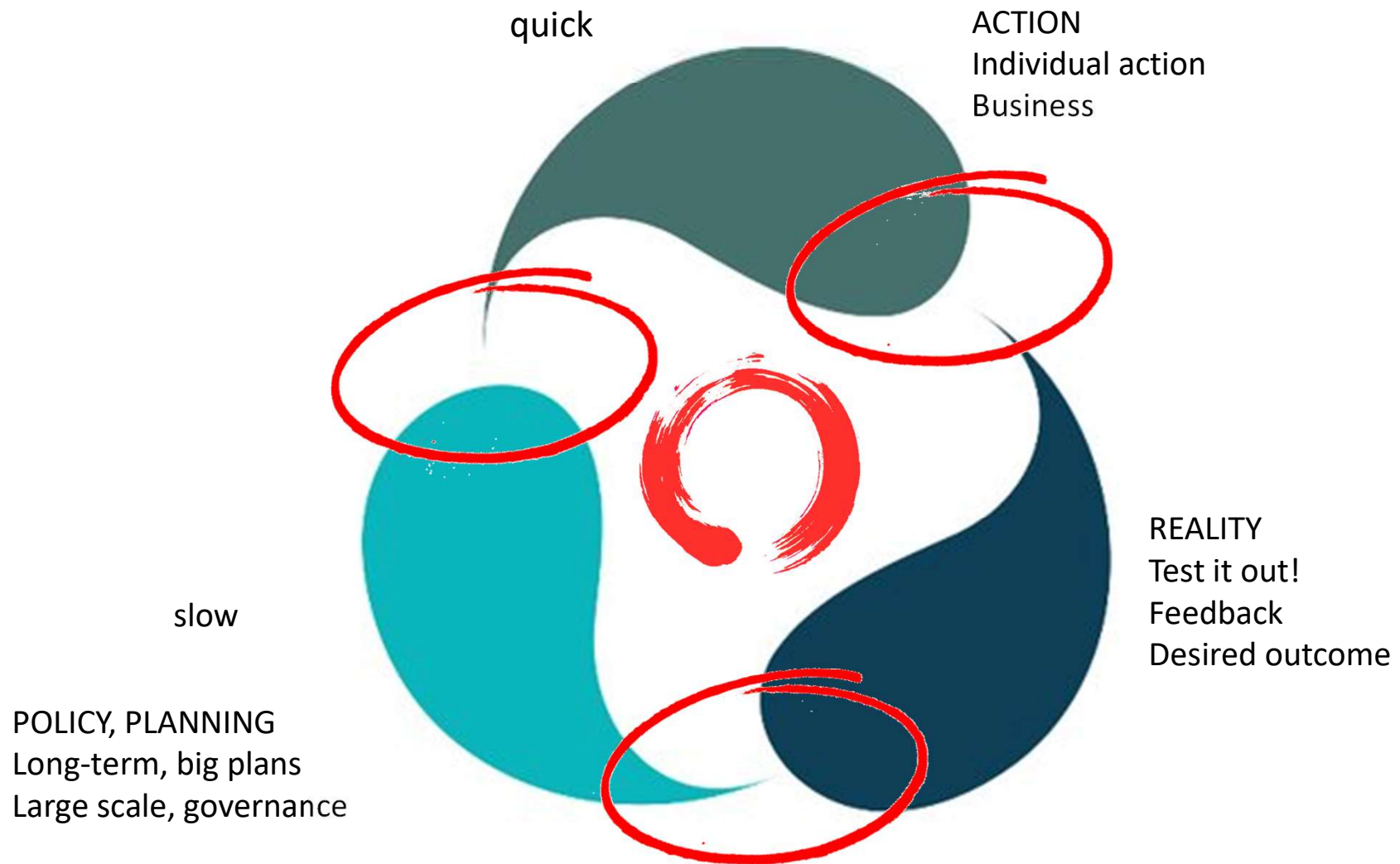
Your pain is the breaking of the shell  
that encloses your understanding.

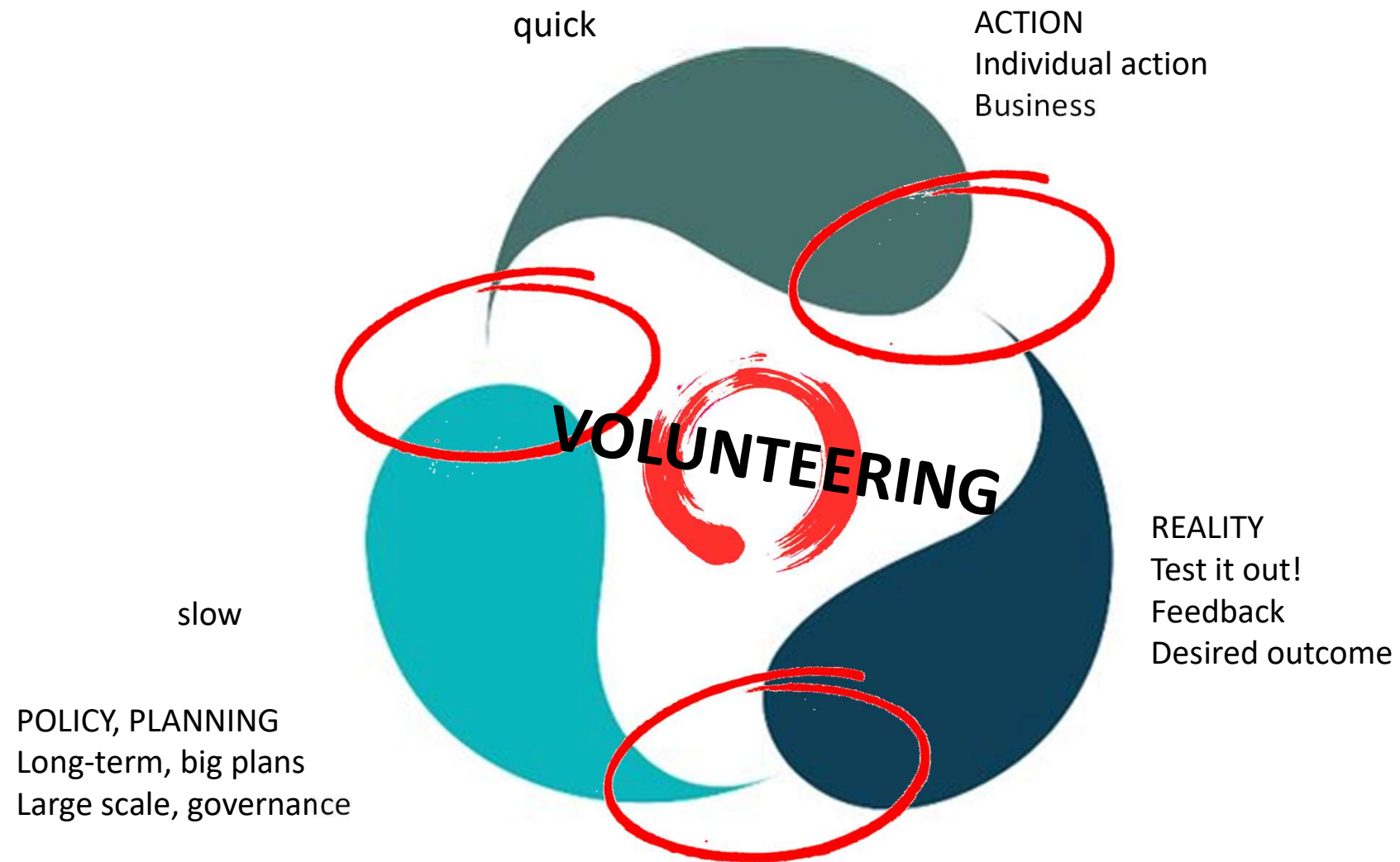
Khalil Gibran

[siteofwisdom.com](http://siteofwisdom.com)

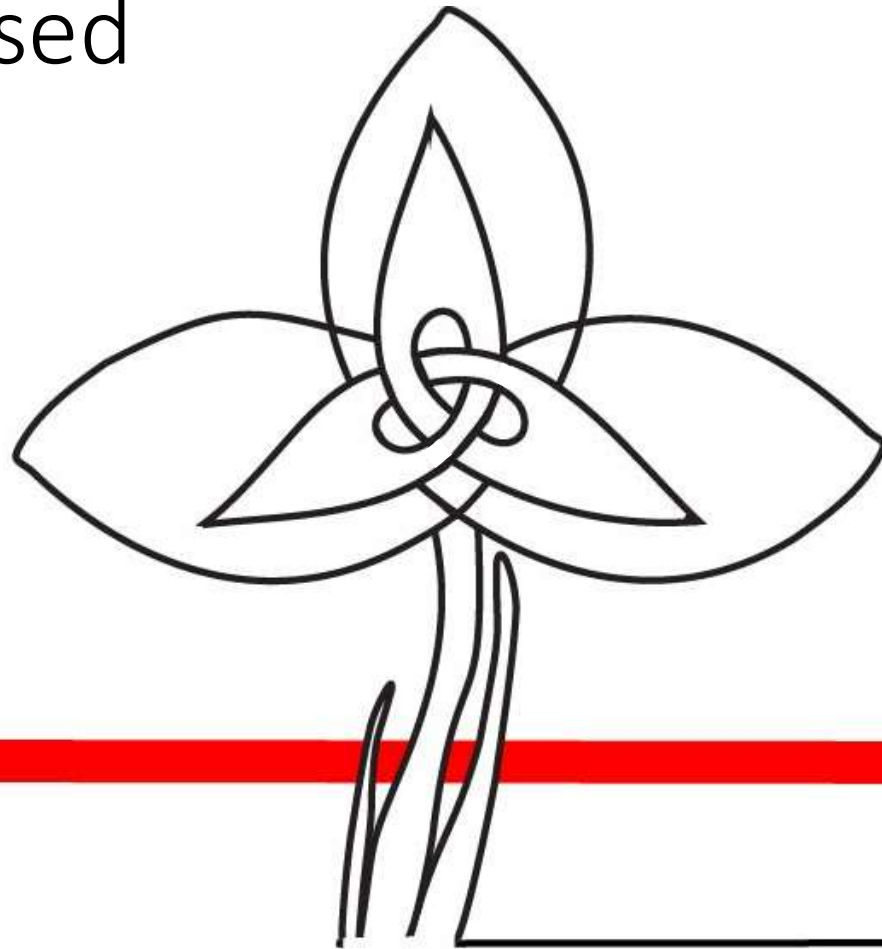








creatively confused



Beneath, Between and Beyond

(TEDxPrinceAlbert 2012 logo with thanks to Helene Smit)

<https://www.ted.com/tedx/events/4016>

#WSD is great and all, but ...





Water sensitivity is more than  
water supply and distribution –  
also about the ecosystem,  
nutrient cycling, energy use and  
our culture around water ...  
**Water consciousness?**

Renenerative Water Services  
Water Sensitive Design  
Basin Connected Cities  
Water-Wise Communities



[iwa-network.org/projects/water-wise-cities](http://iwa-network.org/projects/water-wise-cities)



AquaSavvy is all about **creating liveable spaces, building connections, and showcasing water sensitive research.**

[www.aquasavvy.co.za](http://www.aquasavvy.co.za)



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[www.ceber.uct.ac.za/](http://www.ceber.uct.ac.za/)





“What do you do and how did you get there?”

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<https://thenounproject.com>

Serendipity: building a house in the drought, WSD, lived in a shack without services for 2 years, overlooking the vlei

# THINK WATER



If everyone in Cape Town with access to a flushing toilet, flushed ONCE less a day we would save up to

**23.1 million litres per day!**

The proposed TMG Aquifer Scheme will only yield

**10 million litres per day at a project cost of approx. R85 million \***

Based on 89% of the 3.74 million population having access to flushing toilets, at an average of 7 litres per flush

\* Source – City of Cape Town

**23 ML to flush toilets in Day Zero?  
Not with MY 25L!!**

# To toilet or to toilet

1.5 L urine per day. (10L a week. 40 L a month) -> garden, green stuff.

0.5kg faeces a day. (3.5kg a week, 14kg a month).

20L bucket a month

Once it's full, pop a lid on it, put it somewhere else for 6 months.





# Toilets in the time of Day Zero.

Sewer problems.

What to do with the stuff if I don't have a garden?

What would the city do? SWM?

What can I do?



# Looking forward: Toilets after Day Zero

(my research)

# Definition: Environmental sanitation

Sanitation

Stormwater

Solid waste management

Energy-water-waste nexus: if you use the one, you are in effect using the other.

Also holds for food-transport-building

Coming to terms with being part of nature, for better or worse

Multifunctional spaces, productive spaces

Resource recovery, 'wastewater biorefineries' , circular economy,

**Coping with diffuse pollution as an opportunity**



“What do you do and how did you get there?”

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2013 - 2016



wastewater biorefineries



bacteria



algae



plants



fungi

**Zombie apocalypse** “If/when it all goes  
pear-shaped, what do I need to know?”

animals

# The Wastewater Biorefinery

## Why these unit operations?

---

- **Heterotrophic microbial:** great control, well understood, good C removal. “bacteria”
- **Photomixotrophic:** nitrogen and phosphorous removal, greater energy contribution from photosynthetic activity “algae”
- **Macrophyte bioreactor:** polishing step, nitrogen and phosphorous removal “plants”
- **Solids:** (dominant group expected to be fungal organisms), bioprocessing of high solids content “sludge”
- **All:** robust, resilient, ecosystem, using many different metabolisms



## Three concepts:

- jouissance
- tame is not sustainable
- inverse infrastructures

# JOUISSANCE

... a brief flash of enjoyment achieved after excessive pursuit.

The pleasure lies in the obstacles to fulfillment - but only if that fulfillment eventually arrives, and only if there are obstacles.

*jouissance* |ZHwe'-saNs|  
noun

Physical or intellectual pleasure, delight or ecstasy.  
from the French *jouir* "enjoy"

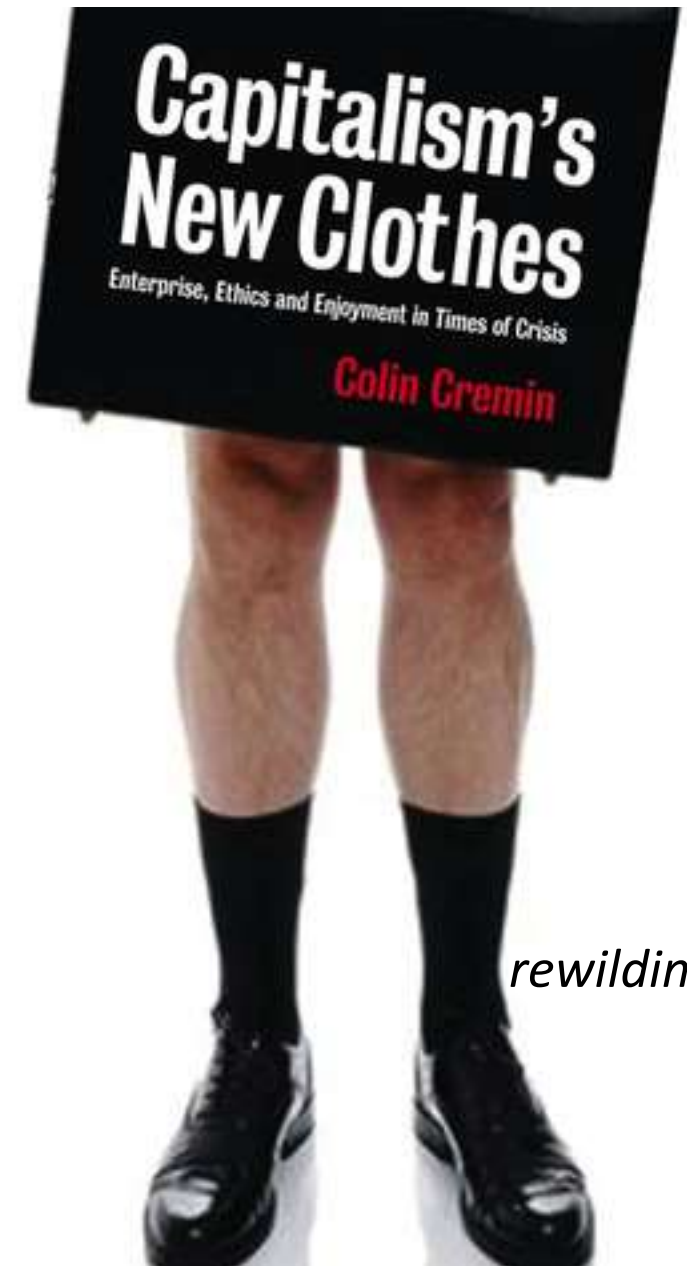


# Tame Is Not Sustainable

Wealth is about taming.

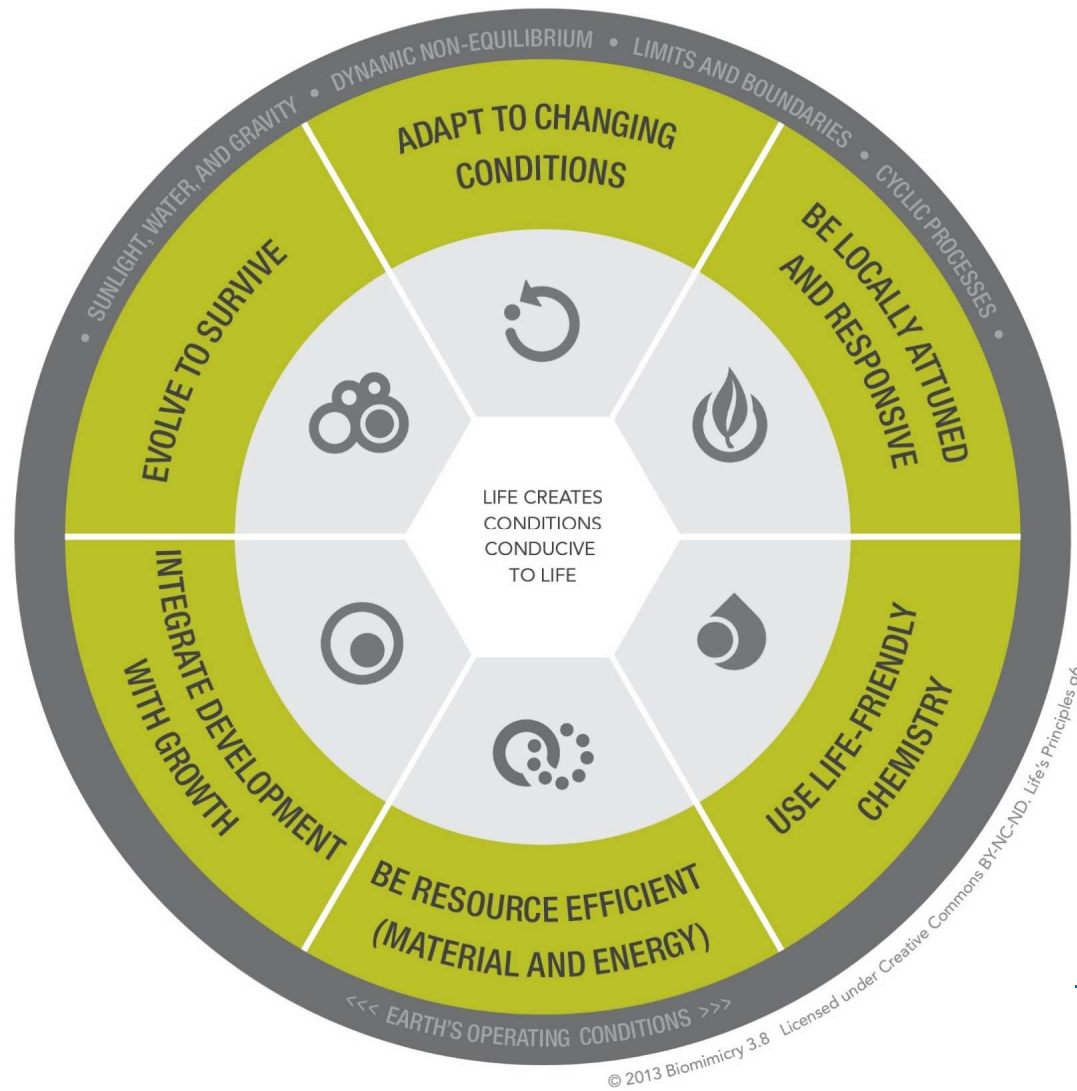
Taming is about externalizing consequences.

Tameness takes away jouissance.



*rewilding*

*rewilding*



<https://biomimicry.net/the-buzz/resources/biomimicry-designlens/>

It doesn't have to be all or nothing



# Inverse Infrastructures

Renewable energy

Bottom up internet

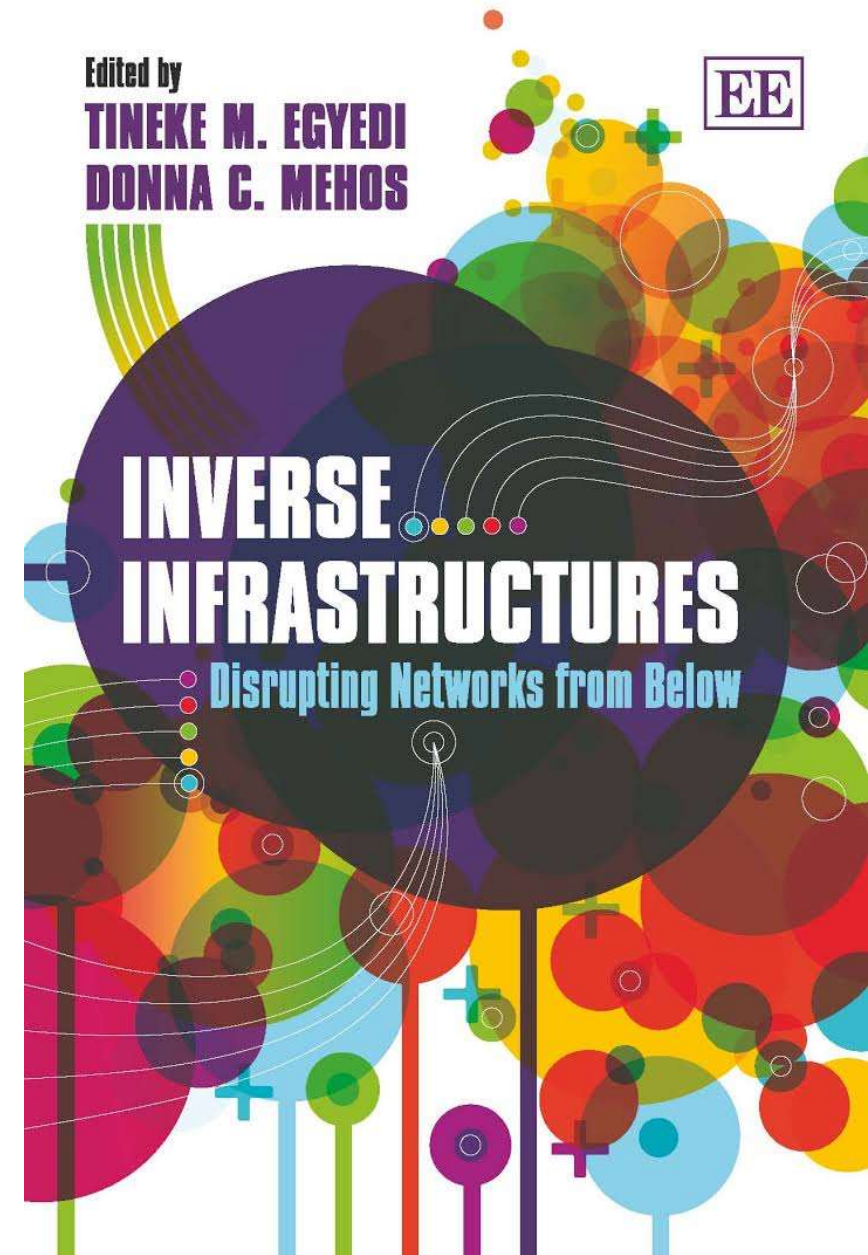
...

Rainwater harvesting

Alternative water sources

People doin' it for themselves

<https://www.edx.org/course/next-generation-infrastructure-delftx-ngix-1>





Serving yourself is easy, but ...



Income & equity

Risk

MAD: monitoring, analysis, decision-making

Appropriate scale



# Darmstadt semi-zentral

**as large as necessary, but as small as possible**

The disadvantages of conventional large (centralized) or small (decentralized) systems can be avoided while utilizing their benefits at the same time

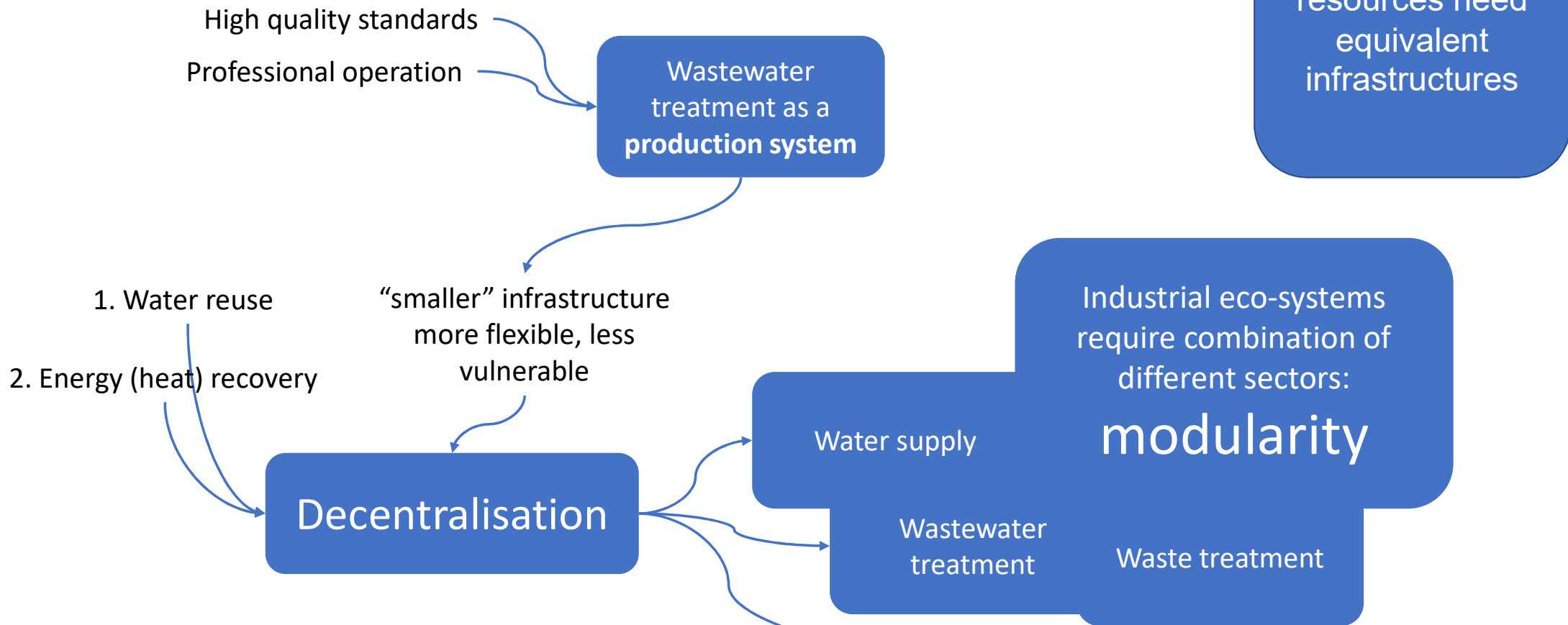


[www.semizentral.de/](http://www.semizentral.de/)

[indiebio.co.za/resources](http://indiebio.co.za/resources)

[http://indiebio.co.za/wp-content/uploads/2017/11/Verster et al 29nov17 Peri Urban Sanitation WWBR.pdf](http://indiebio.co.za/wp-content/uploads/2017/11/Verster_et_al_29nov17_Peri_Urban_Sanitation_WWBR.pdf)

# Decentralisation? Appropriate scale?



Inspired from [www.semizentral.de/en/publications/publications/#dropdown](http://www.semizentral.de/en/publications/publications/#dropdown)

Context: House Jouissance

# THE HOUSE THAT **BERNELLE** BUILT

‘off-grid with regards to water’  
– Is it? Should it be?

[indiebio.co.za/house-jouissance](http://indiebio.co.za/house-jouissance)

PROJECT:  
HOUSE JOUISSANCE



Insulated  
Double glazing  
Thermal mass: protect  
against intense heat/cold on  
Western side  
Solar thermal geyser

Large roof overhangs  
Large deck (shady bits)  
L-shape: protect against  
South-Easter

Small: 89m<sup>2</sup> (960sqft)



Rainwater harvesting to duckpond

Stormwater ponds 'leidamme'

Dry toilet

Shower water directly to garden – trees

Bathroom basin to sheep trough – dog cool-off station, resident frog, duckweed nursery

Kitchen waste to sewer ... (minimal)



To view a video of the  
rammed earth portion of this  
project, visit the brand new  
earthworks YouTube channel  
<http://bit.ly/2j16i1k>









Take-off from road  
(illegal?)



Front: Feature wall + protective



Treatment  
wetland



\*\* easy sediment removal!!

Back wall of leidam  
Two taps





Windbreak, 'Swales' / Terraces



Gutter diversion to fishpond, duckpond, whatever pond I need



Gutter diversion to leidam



Bathroom basin to dog-cooling station, duckweed nursery







# Urban estuaries: Zandvlei



‘The toilet / scorecard  
of the catchment’



<https://citymaps.capetown.gov.za/EGISViewer/>

[www.zpaac.org.za](http://www.zpaac.org.za)

**Increased Nutrient Input**

**Hardened Catchment**

**Rivers Canalized**

**Sediment**

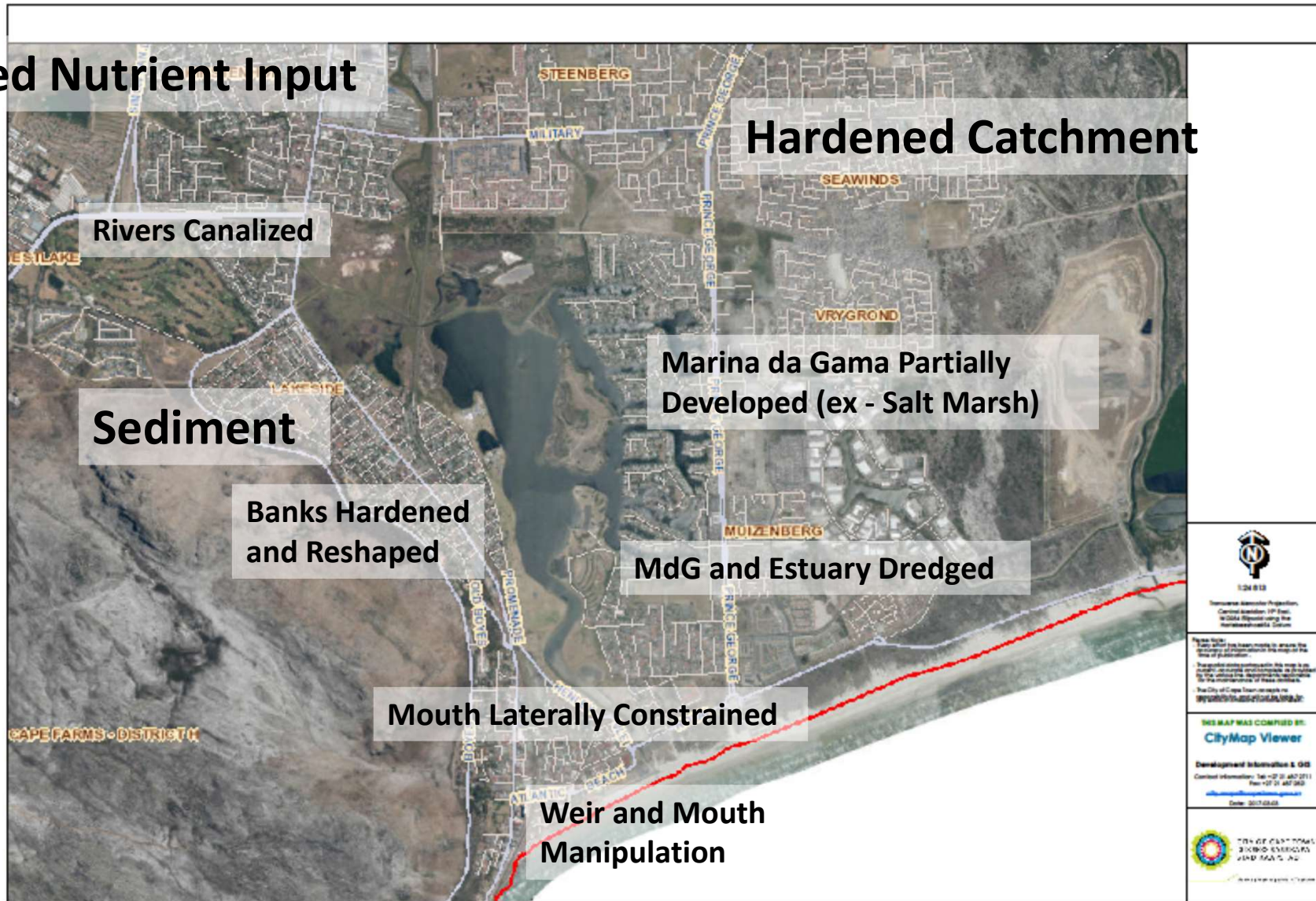
**Banks Hardened  
and Reshaped**

**Marina da Gama Partially  
Developed (ex - Salt Marsh)**

**MdG and Estuary Dredged**

**Mouth Laterally Constrained**

**Weir and Mouth  
Manipulation**





**Increased Nutrient Input**

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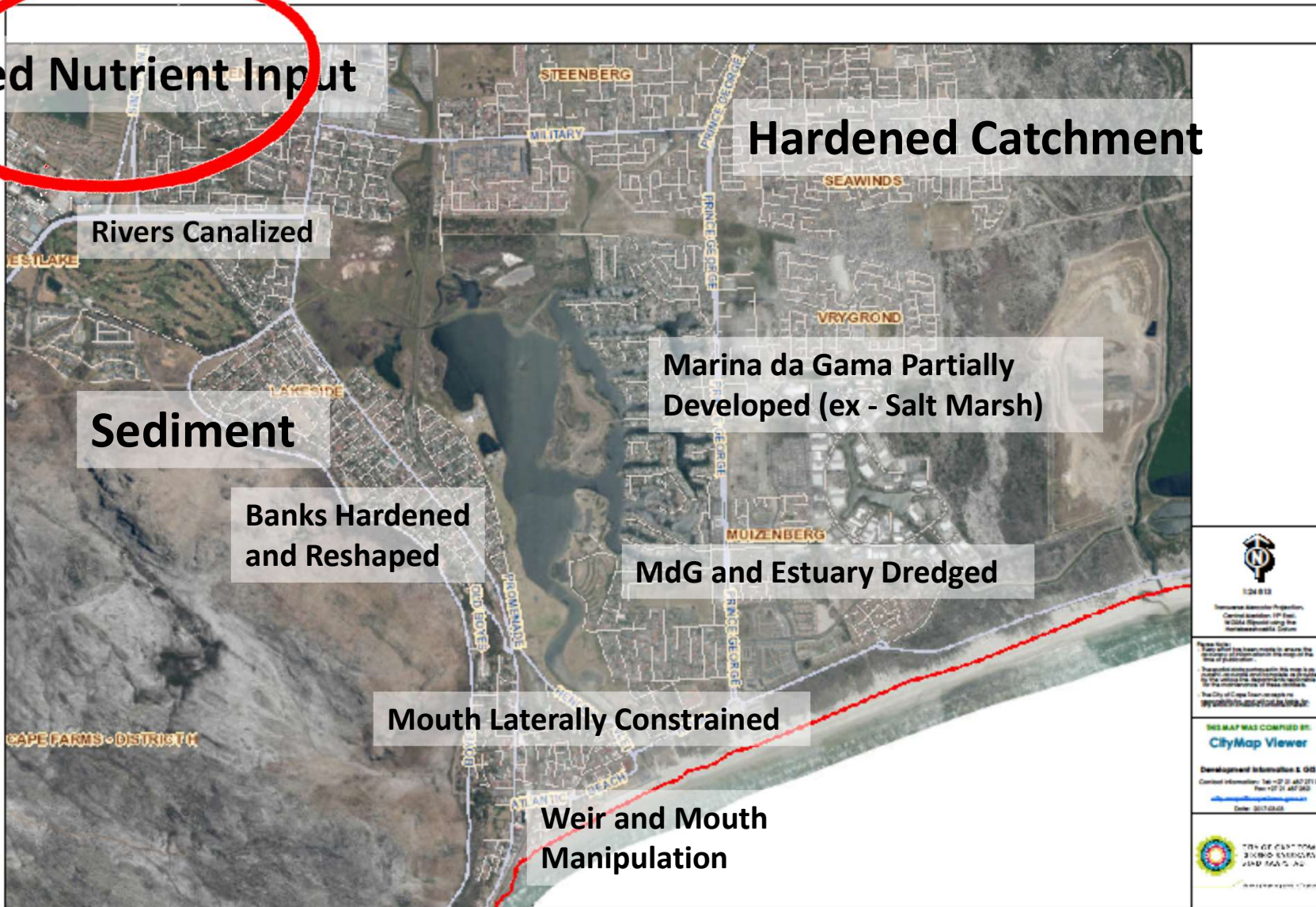
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## The case for the dry toilet EVEN in a perfect system

1. Nutrient recovery: food security, soil health
2. Producing N, mining P bad for environment: imbalanced cycle, NOx greenhouse gas
3. Dry toilet waste more concentrated, easier to recover
4. Dry toilet infrastructure is cheaper than flush infrastructure
5. Effluent even from well managed wastewater treatment works = eutrophication

indiebio.co.za/resources

[http://indiebio.co.za/wp-content/uploads/2017/11/Verster et al 29nov17 Peri Urban Sanitation WWBR.pdf](http://indiebio.co.za/wp-content/uploads/2017/11/Verster_et_al_29nov17_Peri_Urban_Sanitation_WWBR.pdf)

# What do I consider non-negotiable in a toilet?

Convenience is assumed. As it should be.

Dignity, Convenience, safety, of course.

Assumed that this can be delivered only by white ceramic flush?

- Good natural light
- Indoors
- No flies
- No smell



**Nowhere in this list am I bothered by if it's flush or dry.**

Dry / extremely low flush / foam flush virtually indistinguishable



The dry toilet is connected to a drum that can be emptied out once the waste has dried and reduced in volume. Sawdust helps to absorb moisture thus aiding the drying process.



**THE LIVING LABORATORY**  
Verster has his plans for her mostly indigenous

will include a formal Zen garden with indigenous plants that mimic small Japanese flowers. a

If rich people are not willing to use the most sustainable sanitation systems, how can we expect poor people to use it?



# Outside vs within

Preservation of nature (us outside) vs productivity (part of nature, working together)

Conclusion, where to from here?

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Create new cultural norms, that is built around thriving in relationship with our wider systems, more than coping with scarcity.

Change behaviour, not the source of where you get your water from.

Long term plans are the best way to prevent emergencies. This is out of the hands of individuals. We need the bigger plans for economically attractive, vibrant, liveable cities, to have secure systems.



# Conclusion, where to from here?

Create new cultural norms, that is built around thriving in relationship with our wider systems, more than coping with scarcity.

Change behaviour, not the source of where you get your water from.

Long term plans are the best way to prevent emergencies. This is out of the hands of individuals. We need the bigger plans for economically attractive, vibrant, liveable cities, to have secure systems.



So, off-grid? Is my house? Maybe a little bit in the conventional sense of the word, but not really – everything is connected. Should it be? No.

# The bottom line

The things we need to do to avoid the bad scenarios, are the same things we need to do once the bad things have happened, to adapt and survive.

The informed route forward looks the same regardless.

# Continue the conversation

## Bridging Waters Conversation Series

- Cape Town as a Sponge City
- Moving towards a Water Sensitive Culture
- What is a catchment?
- Trees

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[www.futurewater.uct.ac.za/uct-summer-school](http://www.futurewater.uct.ac.za/uct-summer-school)

[www.futurewater.uct.ac.za/get-touch](http://www.futurewater.uct.ac.za/get-touch)



[www.aquasavvy.co.za](http://www.aquasavvy.co.za)