UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

Centre for Water Resources Research

Citizen Science as an Enabler for Integration and Implementation

Dr Sabine Stuart-Hill

Centre for Water Resources Research (CWRR)

Stuart-Hills@ukzn.ac.za

033 260 5460

With contributions from Ntombiyenkosi Nxumalo (NRF Intern) and partially funded by the WRC of South Africa

Points of Departure

- WEF Nexus presents itself differently on different scales.
- Sustainable living and well-being needs a localised view,
- and thus, context specific governance.
- Water, energy and food security represent basic needs of well-being and empowerment.
- In Southern Africa water quality is overtaking water quantity as the main threat to water availability.

The SDGs: A New Agenda for Sustainable Development

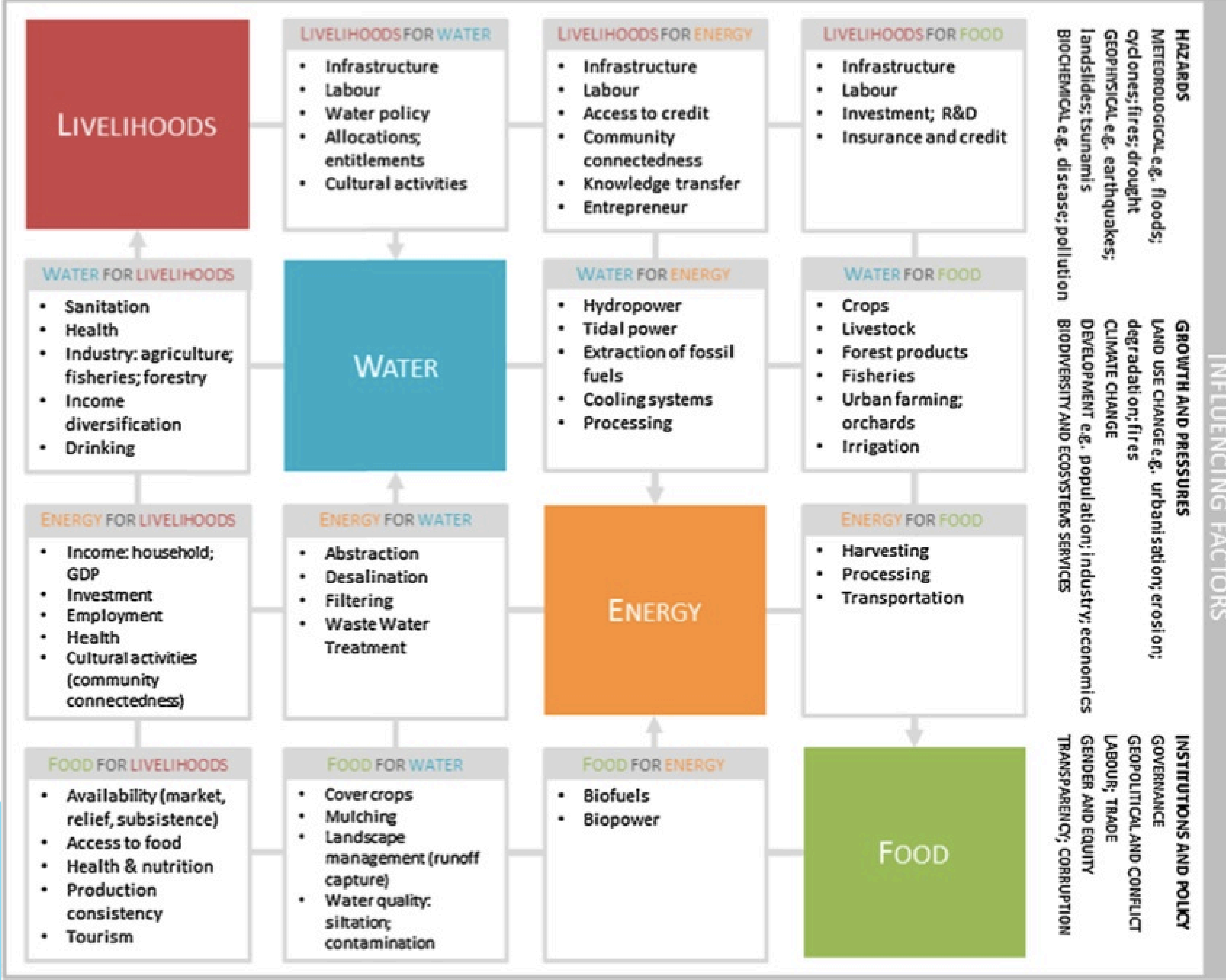
- A people centric vision, including aims such as dignitiy, prosperity and well-being on the backdrop of environmental protection and respectful use thereof.
- Such sustainable living and well-being needs a localised view, and thus, context specific governance.

Energy, food and water security are basic elements for **livelihoods**,

BUT well-being goes beyond this and requires a localies view to **capture local phenomena and context**.

Definition of terms

- WATER MANAGEMENT: ”Management refers to activities of analyzing and monitoring, developing and implementing measures to keep the state of a water resource within desirable bounds.” (Pahl-Wostl *et al.*, 2012, 25)
- WELL-BEING: ”[…] it puts emphasis on relational and collective processes […] and reflects the importance of social, psychological, and cultural needs required to thrive” (Armitage *et al.*, 2012)
- VULNERABILITY: A state of an individual, community, sector or organisation based on its exposure, sensitivity and coping capacity to climate change impacts. Consequently, vulnerability is “determined by social entitlements” (Adger, 2001, 925) and the property of ‘adaptive capacity’ as a responsive element can mitigate impacts and therefore reduce vulnerability to a certain extent (Ionescu *et al.*, 2005).



LIVELIHOODS
LIVELIHOODS FOR WATER
Infrastructure
Labour
Water policy
Allocations; entitlements
Cultural activities
LIVELIHOODS FOR ENERGY
Infrastructure
Labour
Access to credit
Community connectedness
Knowledge transfer
Entrepreneur
LIVELIHOODS FOR FOOD
Infrastructure
Labour
Investment; R&D
Insurance and credit
WATER FOR LIVELIHOODS
Sanitation
Health
Industry: agriculture; fisheries; forestry
Income diversification
Drinking
WATER
WATER FOR ENERGY
Hydropower
Tidal power
Extraction of fossil fuels
Cooling systems
Processing
WATER FOR FOOD
Crops
Livestock
Forest products
Fisheries
Urban farming; orchards
Irrigation
ENERGY FOR LIVELIHOODS
Income: household; GDP
Investment
Employment
Health
Cultural activities (community connectedness)
ENERGY FOR WATER
Abstraction
Desalination
Filtering
Waste Water Treatment
ENERGY
ENERGY FOR FOOD
Harvesting
Processing
Transportation
FOOD FOR LIVELIHOODS
Availability (market, relief, subsistence)
Access to food
Health & nutrition
Production consistency
Tourism
FOOD FOR WATER
Cover crops
Mulching
Landscape management (runoff capture)
Water quality: siltation; contamination
FOOD FOR ENERGY
Biofuels
Biopower
FOOD
HAZARDS
METEOROLOGICAL e.g. floods; cyclones; fires; drought
GEOPHYSICAL e.g. earthquakes; landslides; tsunamis
BIOCHEMICAL e.g. disease; pollution
GROWTH AND PRESSURES
LAND USE CHANGE e.g. urbanisation; erosion; degradation; fires
CLIMATE CHANGE
DEVELOPMENT e.g. population; industry; economics
BIODIVERSITY AND ECOSYSTEMS SERVICES
INSTITUTIONS AND POLICY
GOVERNANCE
GEOPOLITICAL AND CONFLICT
LABOUR; TRADE
GENDER AND EQUITY
TRANSPARENCY; CORRUPTION
INFLUENCING FACTORS

The disadvantaged and often poor Southern African citizen

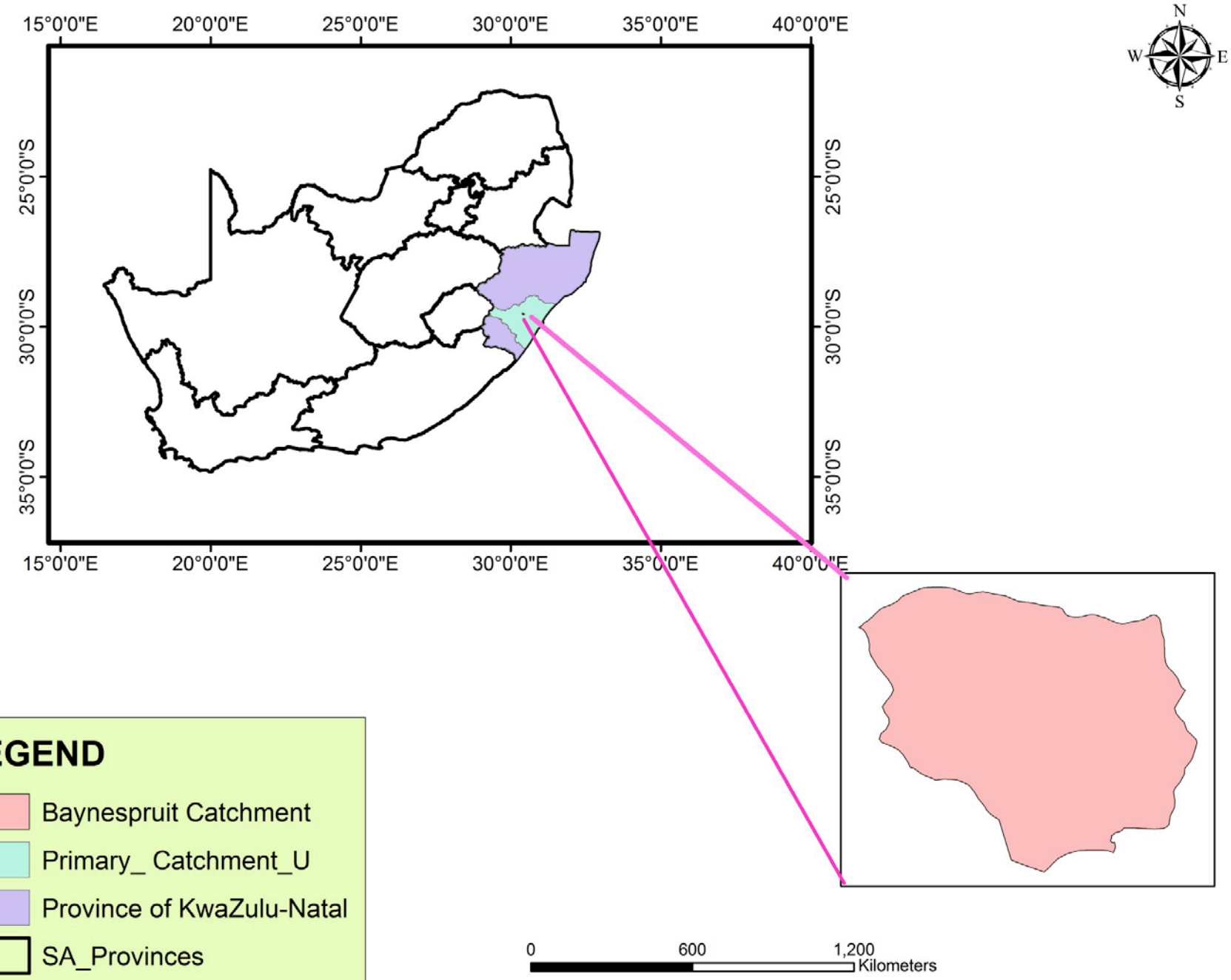
Disadvantaged, poor and informal settlements in urban and rural areas seem to to display very similar attributes of limited social-ecological well-being:

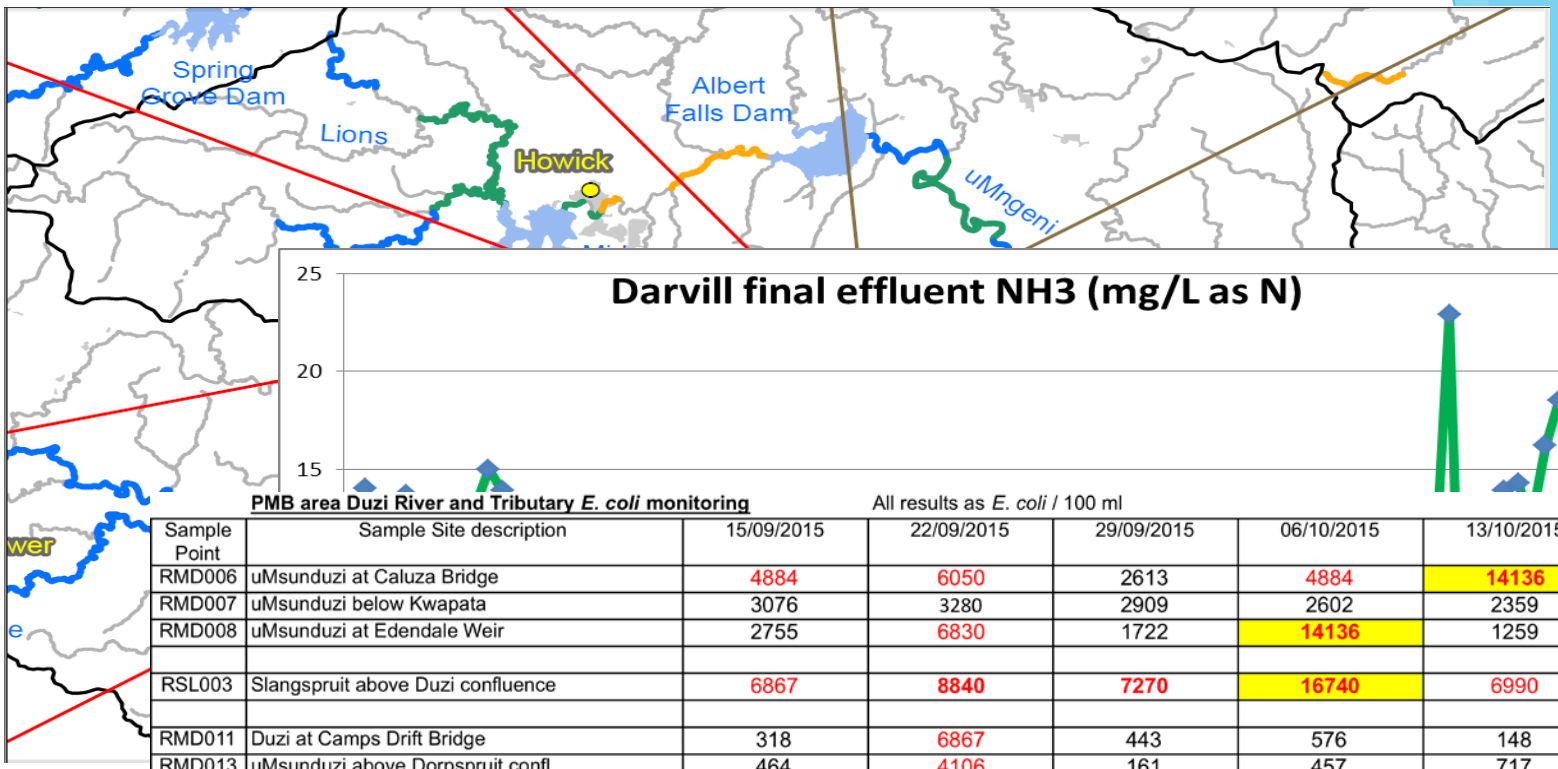
- Often limited access to water and sanitation
- Risks and vulnerabilities of subsistence and emerging agriculture
- Social capital is often disrupted
- Human health in urban areas is more exposed to threats of pollution and diseases
- Access to decision-making in urban settings and influencing thereof seems to be in closer proximity, but may not be anymore accessible, especially to women

How gain insight into such localised context? The Baynespruit sub-catchment as a case study

Sensitivity and Capacity based on the

South African Population Census from 2011

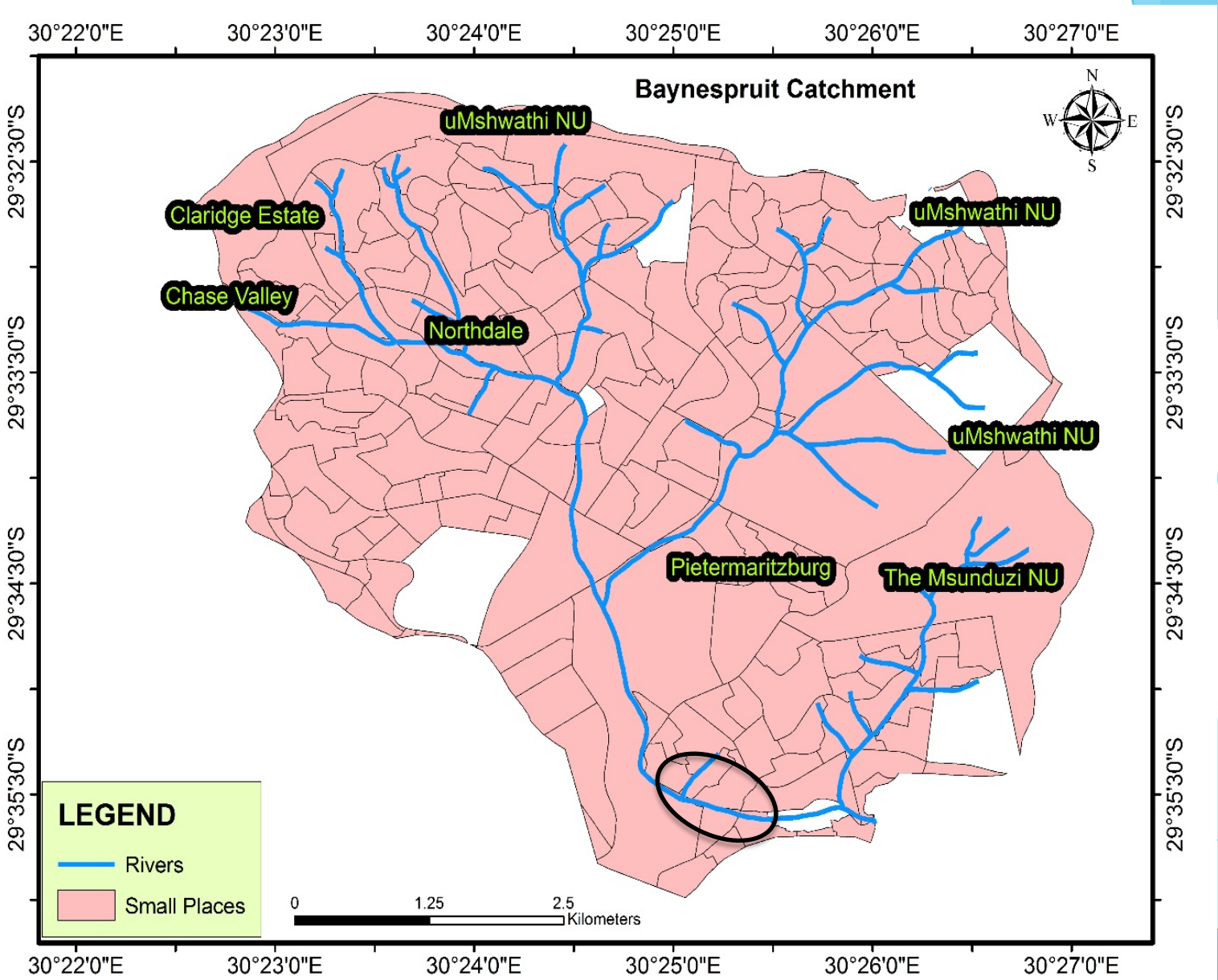

15°0'0"E
20°0'0"E
25°0'0"E
30°0'0"E
35°0'0"E
40°0'0"E
25°0'0"S
30°0'0"S
35°0'0"S
N
W
E
S
LEGEND
Baynespruit Catchment
Primary_ Catchment_U
Province of KwaZulu-Natal
SA_Provinces
0
600
1,200
Kilometers

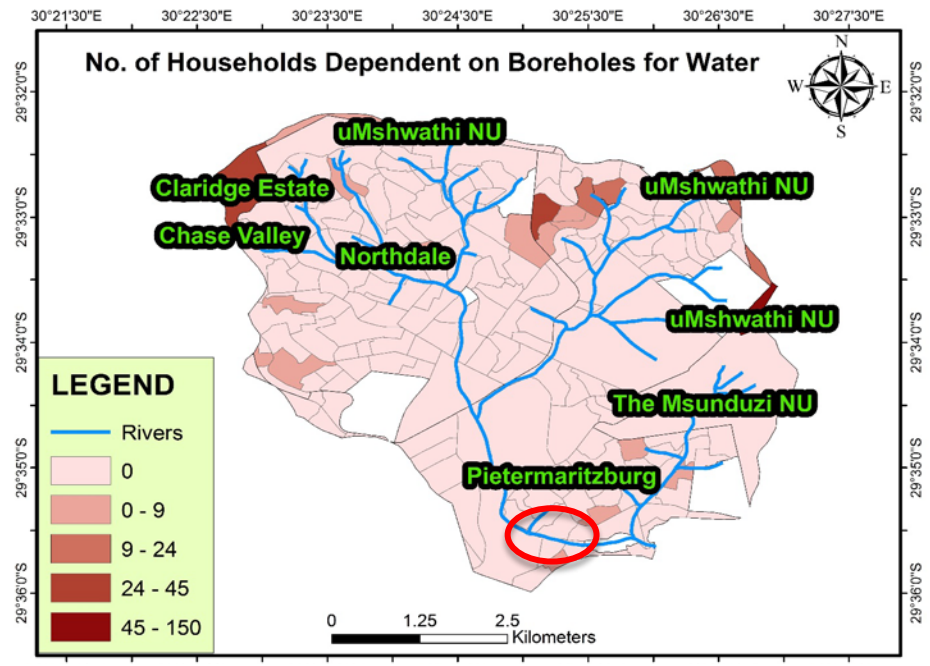


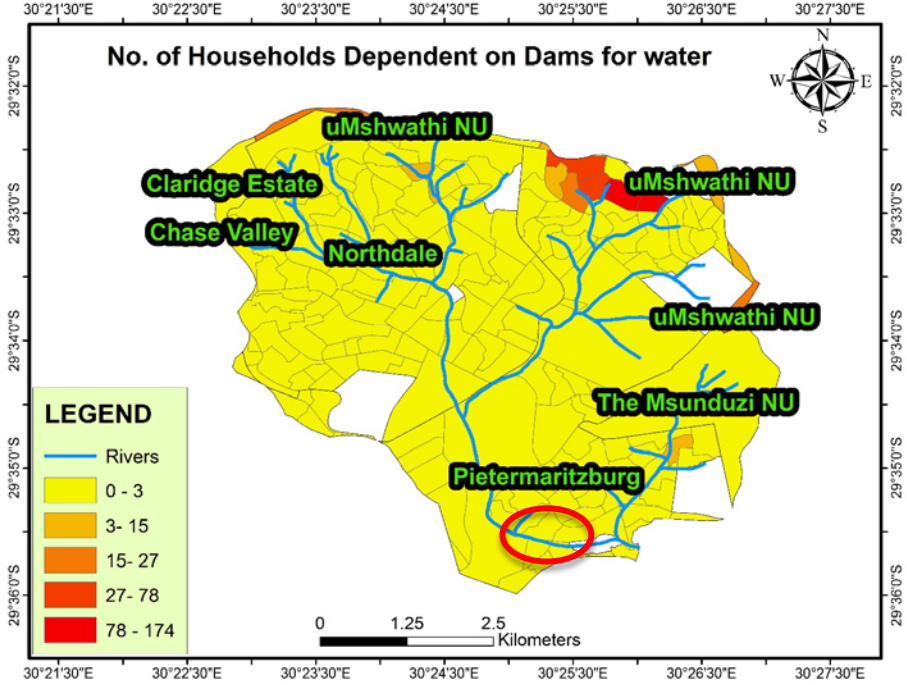
PMB area Duzi River and Tributary *E. coli* monitoring All results as *E. coli* / 100 ml

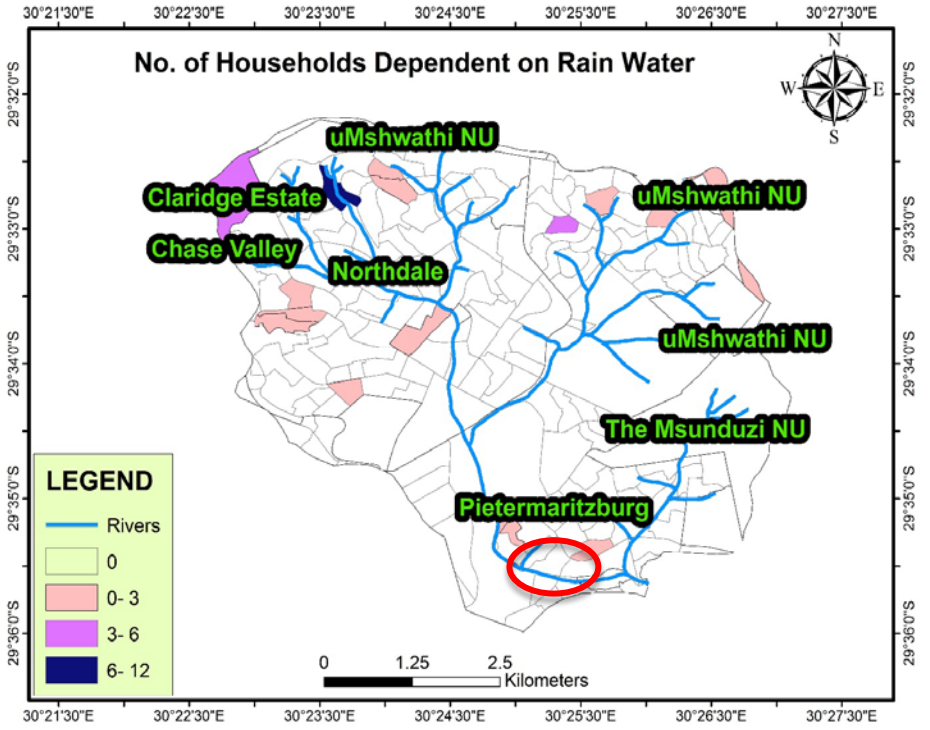
Sample Point	Sample Site description	15/09/2015	22/09/2015	29/09/2015	06/10/2015	13/10/2015	20/10/2015	27/10/2015
RMD006	uMsunduzi at Caluza Bridge	4884	6050	2613	4884	14136	3255	3654
RMD007	uMsunduzi below Kwapata	3076	3280	2909	2602	2359	3255	2382
RMD008	uMsunduzi at Edendale Weir	2755	6830	1722	14136	1259	1935	24196
RSL003	Slangspruit above Duzi confluence	6867	8840	7270	16740	6990	7630	4040
RMD011	Duzi at Camps Drift Bridge	318	6867	443	576	148	110	1616
RMD013	uMsunduzi above Dorpspruit confl	464	4106	161	457	717	452	605
RDS003	Dorpspruit just above Townbush stream	748	10462	2187	2430	19863	2430	9870
RDS004	Townbush Stream just above Dorpspruit	17329	13330	8664	3840	738	1130	3255
RDS005	Dorpspruit Ohrtmann Road / just above Duzi confluence	12670	9900	14210	15000	10460	6090	13540
RMD014	uMsunduzi above Refuse Dump	3873	6867	6867	10462	4611	1850	3448
RMD015	uMsunduzi above Darvill WWW	3448	7270	3873	4352	2098	2489	2489
RMD016	uMsunduzi U/S Baynespruit	4106	9330	2282	3873	2098	3441	2720
RBS001	Baynespruit at Greytown Road	9330	7120	7430	14390	9060	5650	8300
RBS002	Baynespruit behind Epol	9330	4100	410600	22800	34480	6240	12960
RBS003	Baynespruit at Sobantu	980400	770100	235900	307600	105000	222400	275500
RMD017	uMsunduzi U/S Darvill mat river	2980	29090	27550	4810	4040	4106	6130
WDV020	Darvill Final Effluent normal discharge site	100	26020	265	11	17	17	318
RMD018	uMsunduzi D/S Darvill mat river		12460		1970			
RMD019	uMsunduzi at Motorcross weir	7940	43520	24890	840	2430	5172	6630

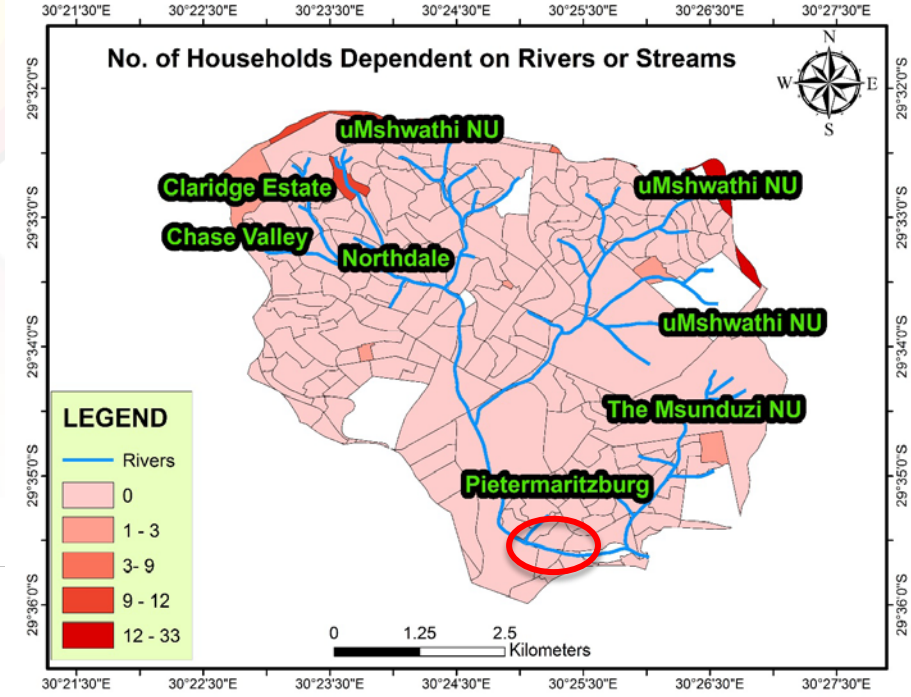
CWRR

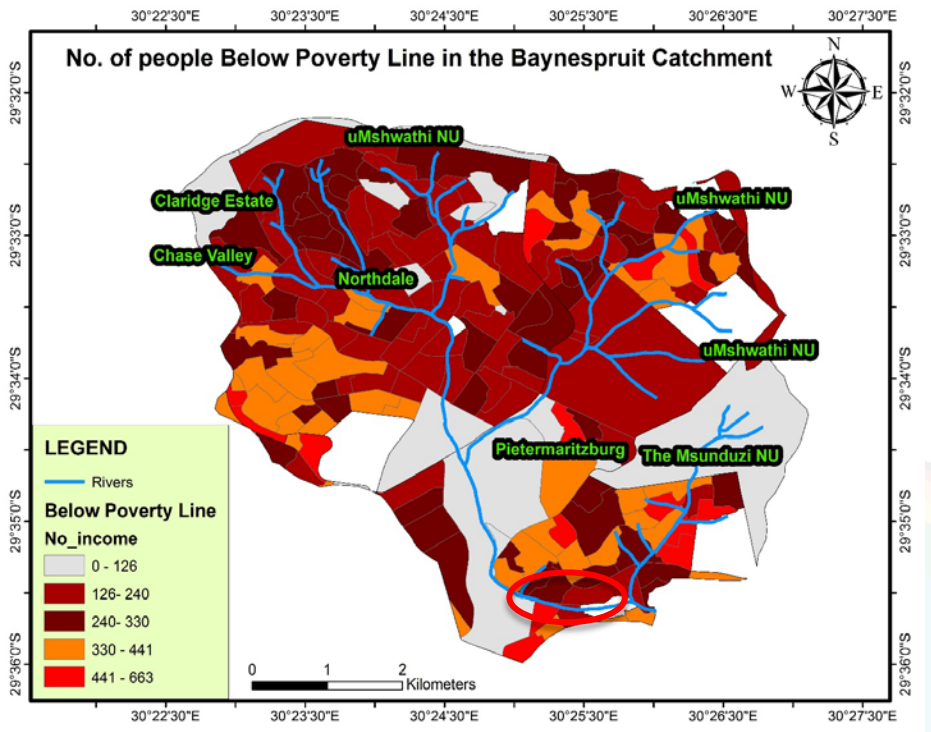

Baynespruit Catchment
uMshwathi NU
Claridge Estate
Chase Valley
Northdale
uMshwathi NU
uMshwathi NU
Pietermaritzburg
The Msunduzi NU
N
W
E
S
30°22'0"E
30°23'0"E
30°24'0"E
30°25'0"E
30°26'0"E
30°27'0"E
29°32'30"S
29°33'30"S
29°34'30"S
29°35'30"S
LEGEND
Rivers
Small Places
0
1.25
2.5
Kilometers

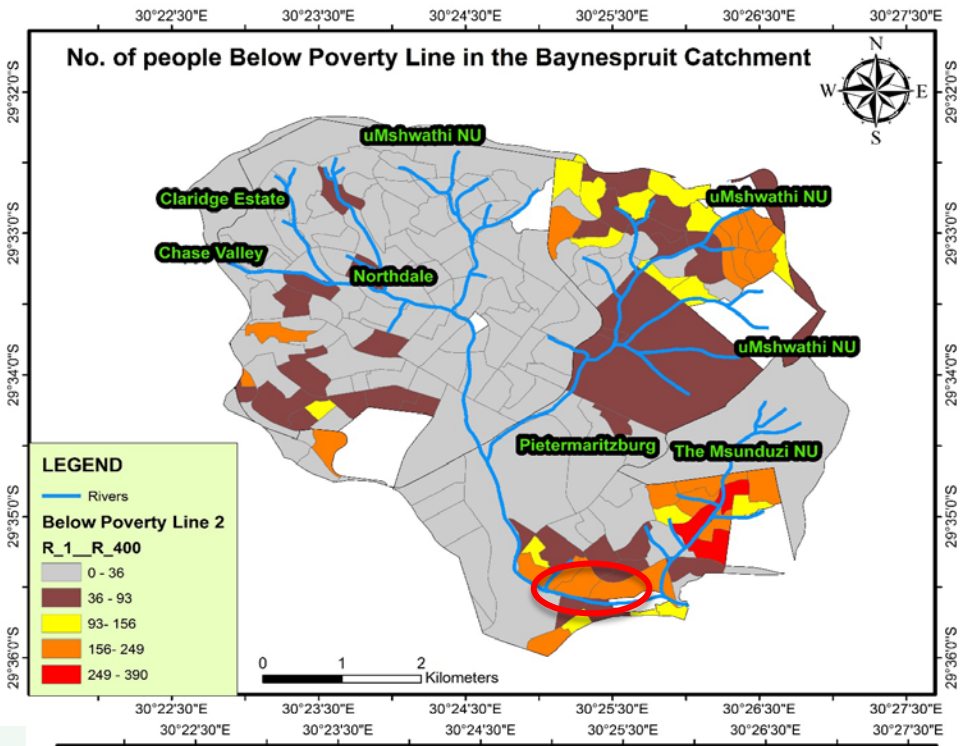

No. of Households Dependent on Boreholes for Water
uMshwathi NU
Claridge Estate
uMshwathi NU
Chase Valley
Northdale
uMshwathi NU
The Msunduzi NU
Pietermaritzburg
LEGEND
Rivers
0
0 - 9
9 - 24
24 - 45
45 - 150
0 1.25 2.5
Kilometers

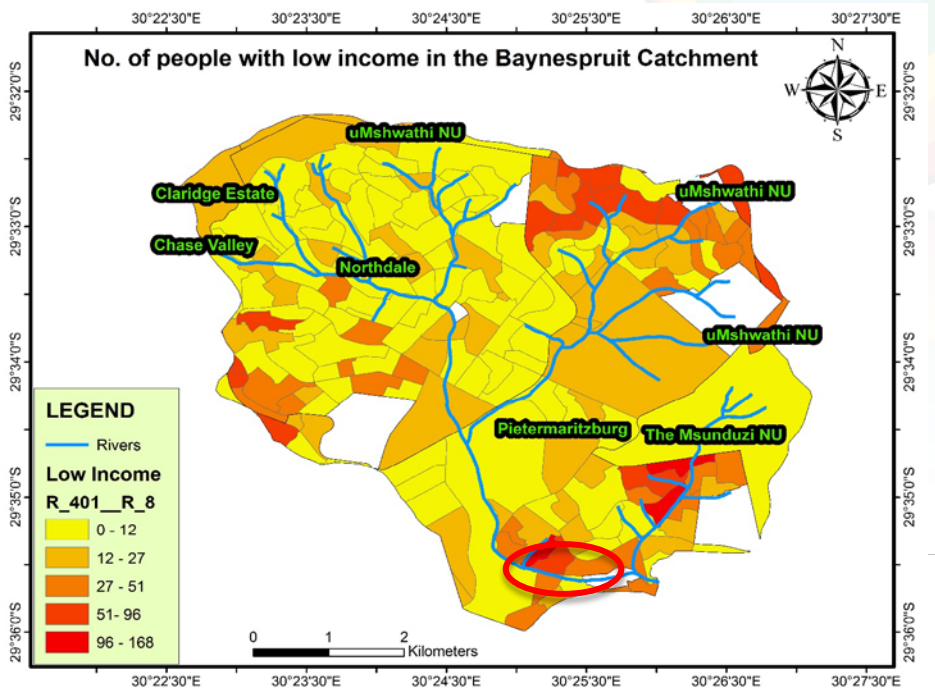

No. of Households Dependent on Dams for water
uMshwathi NU
Claridge Estate
uMshwathi NU
Chase Valley
Northdale
uMshwathi NU
The Msunduzi NU
Pietermaritzburg
LEGEND
Rivers
0 - 3
3- 15
15- 27
27- 78
78 - 174
0 1.25 2.5
Kilometers

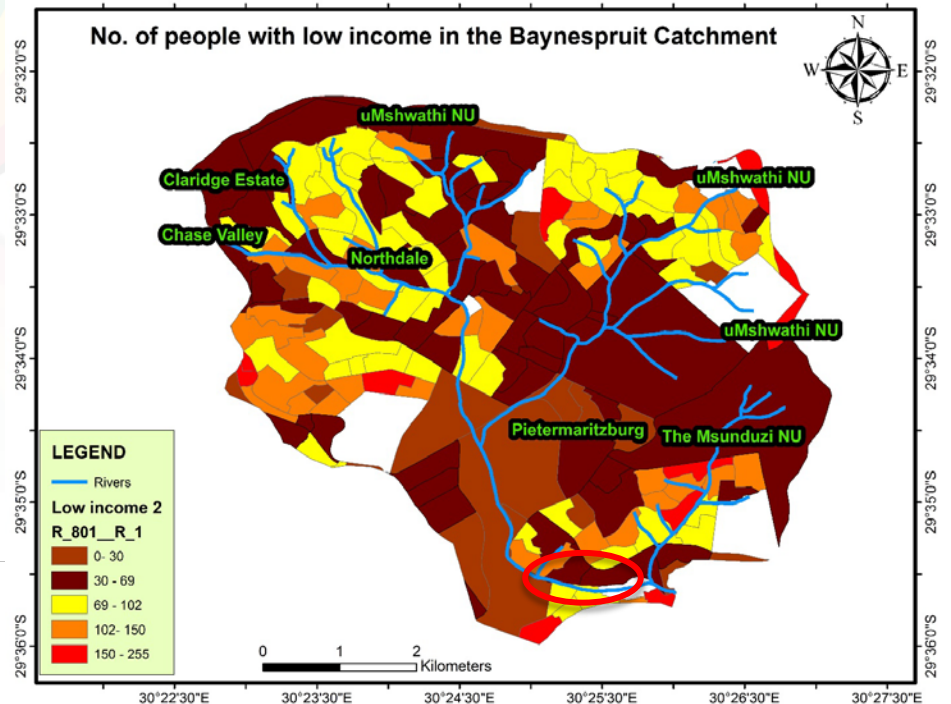

No. of Households Dependent on Rain Water
uMshwathi NU
Claridge Estate
uMshwathi NU
Chase Valley
Northdale
uMshwathi NU
The Msunduzi NU
Pietermaritzburg
LEGEND
Rivers
0
0- 3
3- 6
6- 12
0 1.25 2.5
Kilometers

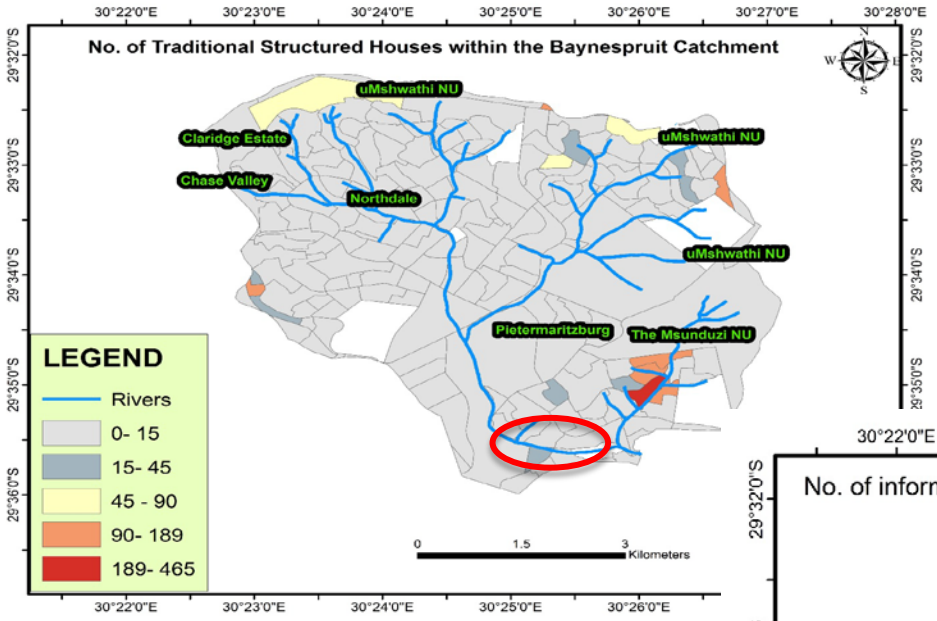

No. of Households Dependent on Rivers or Streams
uMshwathi NU
Claridge Estate
uMshwathi NU
Chase Valley
Northdale
uMshwathi NU
The Msunduzi NU
Pietermaritzburg
LEGEND
Rivers
0
1 - 3
3- 9
9 - 12
12 - 33
0 1.25 2.5
Kilometers

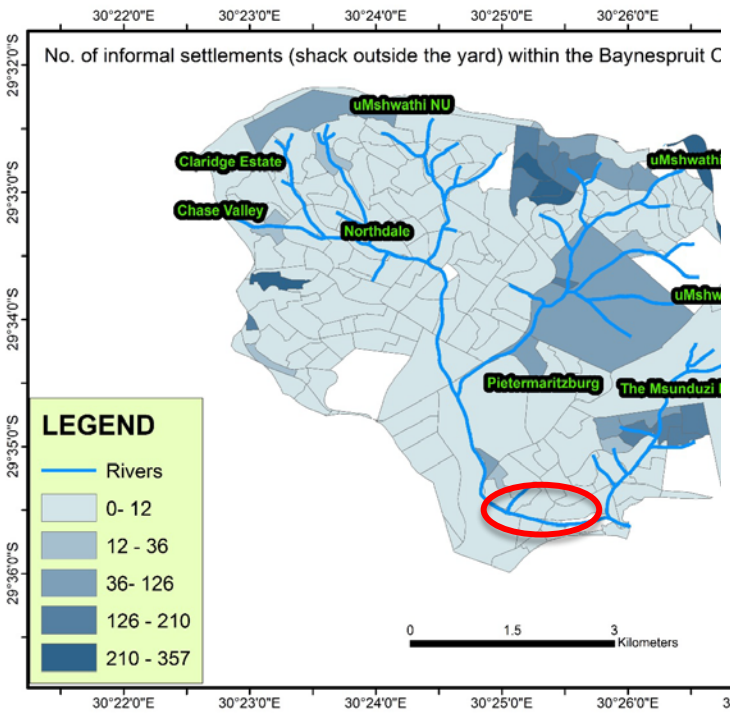

No. of people Below Poverty Line in the Baynespruit Catchment
uMshwathi NU
Claridge Estate
Chase Valley
Northdale
uMshwathi NU
uMshwathi NU
Pietermaritzburg
The Msunduzi NU
LEGEND
Rivers
Below Poverty Line
No_income
0 - 126
126- 240
240- 330
330 - 441
441 - 663
0 1 2
Kilometers
30°22'30"E
30°23'30"E
30°24'30"E
30°25'30"E
30°26'30"E
30°27'30"E
29°32'0"S
29°33'0"S
29°34'0"S
29°35'0"S
29°36'0"S

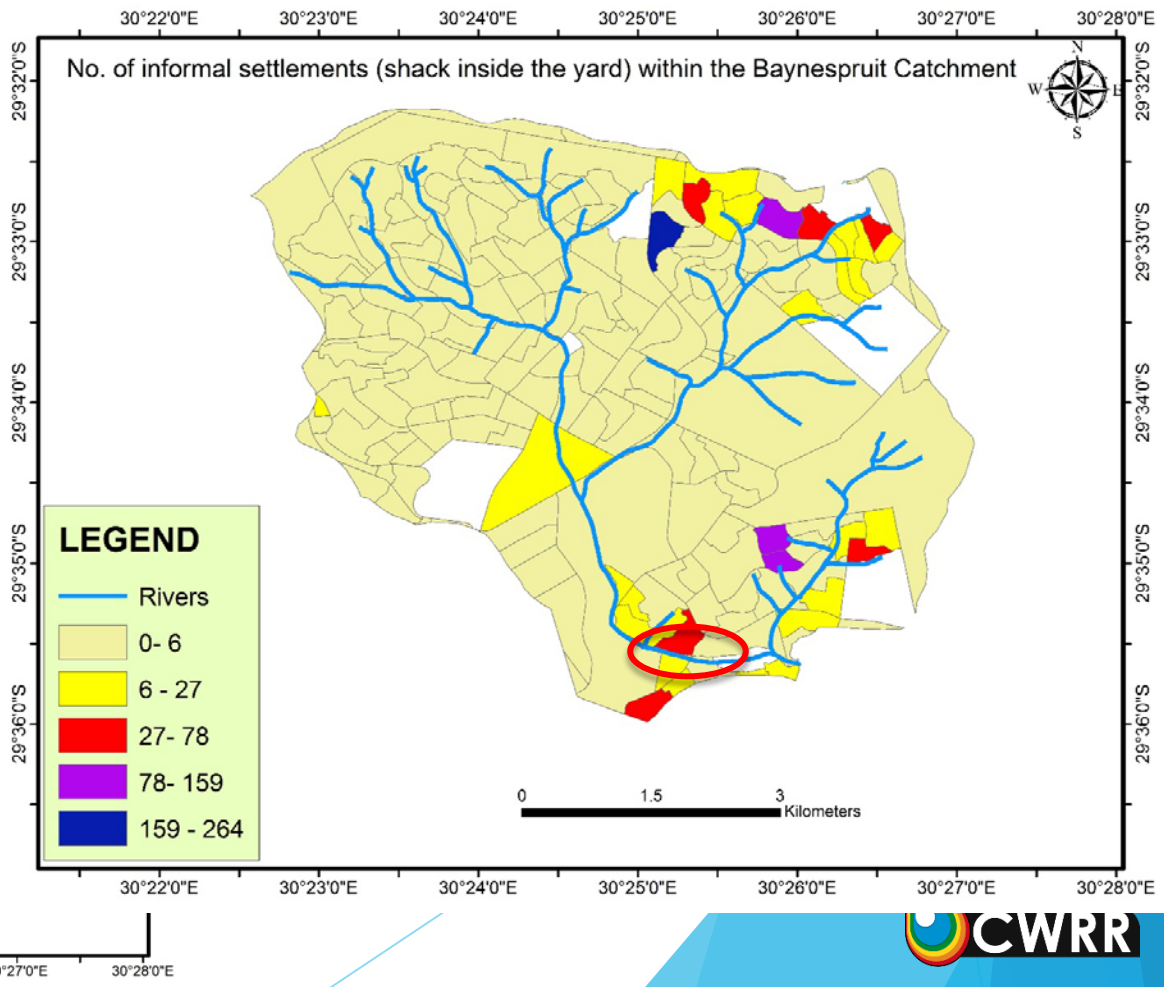

No. of people Below Poverty Line in the Baynespruit Catchment
uMshwathi NU
Claridge Estate
Chase Valley
Northdale
uMshwathi NU
uMshwathi NU
Pietermaritzburg
The Msunduzi NU
LEGEND
Rivers
Below Poverty Line 2
R_1__R_400
0 - 36
36 - 93
93- 156
156- 249
249 - 390
0 1 2
Kilometers
30°22'30"E
30°23'30"E
30°24'30"E
30°25'30"E
30°26'30"E
30°27'30"E
29°32'0"S
29°33'0"S
29°34'0"S
29°35'0"S
29°36'0"S

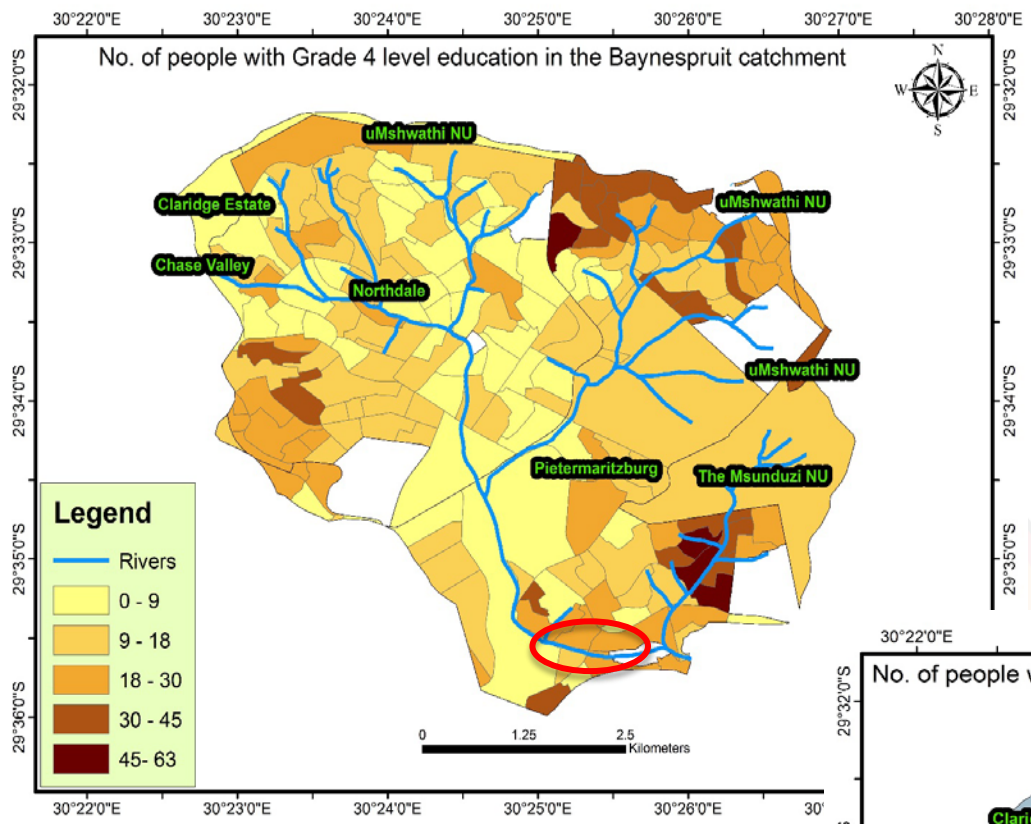

No. of people with low income in the Baynespruit Catchment
uMshwathi NU
Claridge Estate
Chase Valley
Northdale
uMshwathi NU
uMshwathi NU
Pietermaritzburg
The Msunduzi NU
LEGEND
Rivers
Low Income
R_401__R_8
0 - 12
12 - 27
27 - 51
51- 96
96 - 168
0 1 2
Kilometers
30°22'30"E
30°23'30"E
30°24'30"E
30°25'30"E
30°26'30"E
30°27'30"E
29°32'0"S
29°33'0"S
29°34'0"S
29°35'0"S
29°36'0"S

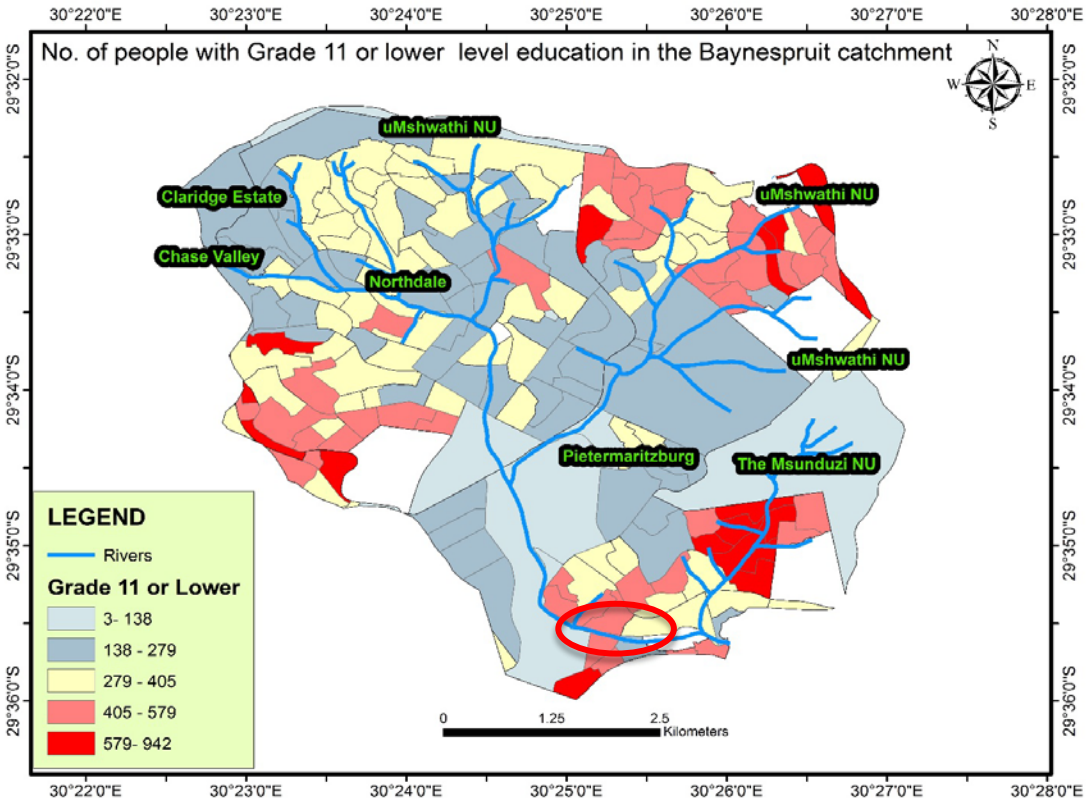

No. of people with low income in the Baynespruit Catchment
uMshwathi NU
Claridge Estate
Chase Valley
Northdale
uMshwathi NU
uMshwathi NU
Pietermaritzburg
The Msunduzi NU
LEGEND
Rivers
Low income 2
R_801__R_1
0- 30
30 - 69
69 - 102
102- 150
150 - 255
0 1 2
Kilometers
30°22'30"E
30°23'30"E
30°24'30"E
30°25'30"E
30°26'30"E
30°27'30"E
29°32'0"S
29°33'0"S
29°34'0"S
29°35'0"S
29°36'0"S

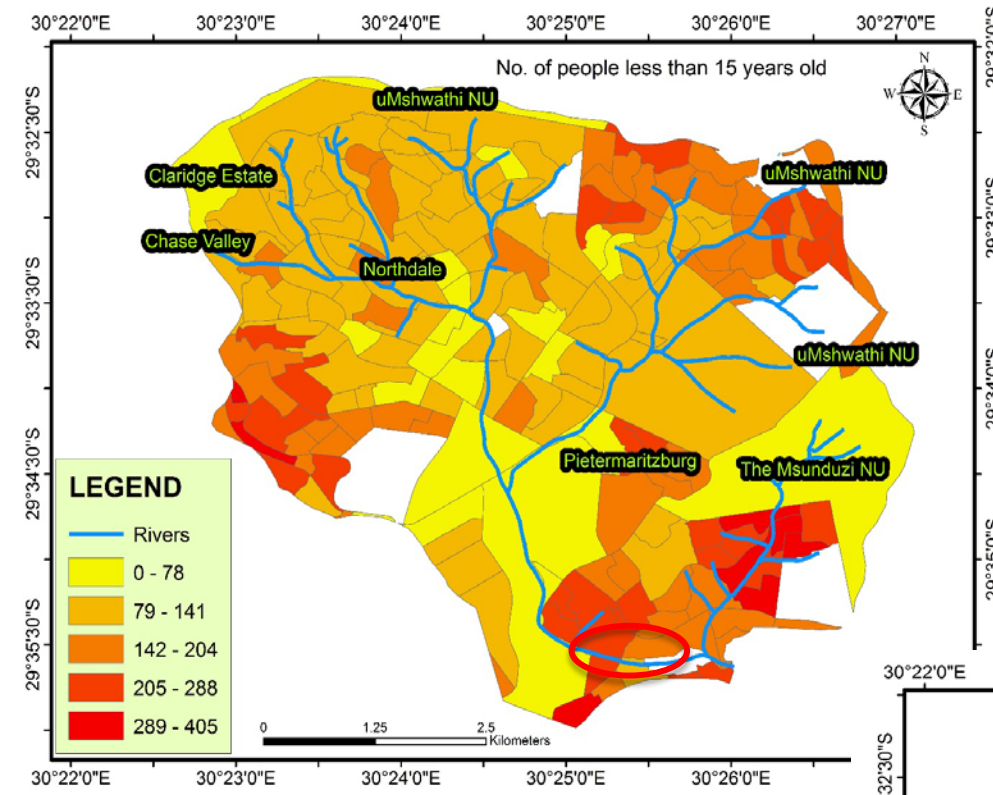

No. of Traditional Structured Houses within the Baynespruit Catchment
uMshwathi NU
Claridge Estate
Chase Valley
Northdale
uMshwathi NU
uMshwathi NU
Pietermaritzburg
The Msunduzi NU
LEGEND
Rivers
0- 15
15- 45
45 - 90
90- 189
189- 465
0
1.5
3
Kilometers

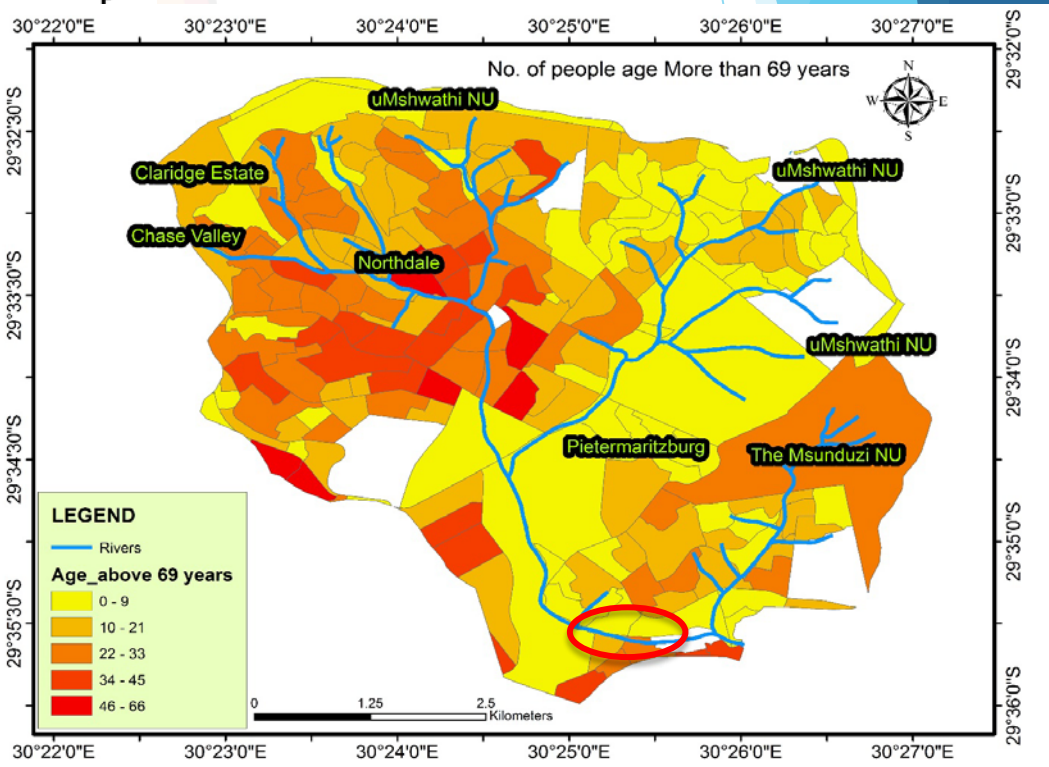

No. of informal settlements (shack outside the yard) within the Baynespruit C
uMshwathi NU
Claridge Estate
Chase Valley
Northdale
Pietermaritzburg
LEGEND
Rivers
0- 12
12 - 36
36- 126
126 - 210
210 - 357
0
1.5
3
Kilometers


No. of informal settlements (shack inside the yard) within the Baynespruit Catchment
LEGEND
Rivers
0- 6
6 - 27
27- 78
78- 159
159 - 264
0
1.5
3
Kilometers


No. of people with Grade 4 level education in the Baynespruit catchment
30°22'0"E
30°23'0"E
30°24'0"E
30°25'0"E
30°26'0"E
30°27'0"E
30°28'0"E
29°32'0"S
29°33'0"S
29°34'0"S
29°35'0"S
29°36'0"S
uMshwathi NU
Claridge Estate
Chase Valley
Northdale
uMshwathi NU
uMshwathi NU
Pietermaritzburg
The Msunduzi NU
Legend
Rivers
0 - 9
9 - 18
18 - 30
30 - 45
45- 63
0
1.25
2.5
Kilometers
N
W
E
S


No. of people with Grade 11 or lower level education in the Baynespruit catchment
30°22'0"E
30°23'0"E
30°24'0"E
30°25'0"E
30°26'0"E
30°27'0"E
30°28'0"E
29°32'0"S
29°33'0"S
29°34'0"S
29°35'0"S
29°36'0"S
uMshwathi NU
Claridge Estate
Chase Valley
Northdale
uMshwathi NU
uMshwathi NU
Pietermaritzburg
The Msunduzi NU
LEGEND
Rivers
Grade 11 or Lower
3- 138
138 - 279
279 - 405
405 - 579
579- 942
0
1.25
2.5
Kilometers
N
W
E
S


No. of people less than 15 years old
30°22'0"E
30°23'0"E
30°24'0"E
30°25'0"E
30°26'0"E
30°27'0"E
29°32'30"S
29°33'30"S
29°34'30"S
29°35'30"S
29°32'0"S
29°33'0"S
29°34'0"S
29°35'0"S
N
W
E
S
uMshwathi NU
Claridge Estate
Chase Valley
Northdale
uMshwathi NU
uMshwathi NU
Pietermaritzburg
The Msunduzi NU
LEGEND
Rivers
0 - 78
79 - 141
142 - 204
205 - 288
289 - 405
0
1.25
2.5
Kilometers


No. of people age More than 69 years
30°22'0"E
30°23'0"E
30°24'0"E
30°25'0"E
30°26'0"E
30°27'0"E
29°32'30"S
29°33'30"S
29°34'30"S
29°35'30"S
29°32'0"S
29°33'0"S
29°34'0"S
29°35'0"S
29°36'0"S
N
W
E
S
uMshwathi NU
Claridge Estate
Chase Valley
Northdale
uMshwathi NU
uMshwathi NU
Pietermaritzburg
The Msunduzi NU
LEGEND
Rivers
Age_above 69 years
0 - 9
10 - 21
22 - 33
34 - 45
46 - 66
0
1.25
2.5
Kilometers

Crops irrigated with water from the river

River used for washing clothes

So how capture, i.e. understand and monitor, such local dependencies, linkages and impacts?

Citizen Science Complementing Conventional Monitoring

- Is community-based science, which basically denotes a partnership between scientists and non-scientists (communities) where data is gathered, shared and interpreted.
- Because of continuous observations, citizens have a better understanding of their own surrounding environment.
- Ensures that realistic frameworks or strategies are developed and implemented.
- Citizen monitoring is financially efficient, i.e. monitoring conducted during non-office hours and potential to infill monitoring gaps.
- Enables building a platform for collaborative water governance and improved social capital.

Mini SASS and Eco-Schools

- SASS = South African Scoring System - is suitable for the assessment of river water quality and river health.
- Rational: drivers, processes, habitat effects = biological response
- Very time intensive assesments, 2 yrs at least; legal review cycles of 5 – 10 yrs

Photo by Liz Taylor

Community Assessment

Good (sensitive taxa)

Fair (intermediate)

Poor (tolerant taxa)

MiniSASS

SITE INFORMATION TABLE		
Date (dd/mm/yr):		
Collectors name:		
River name:		
Site description:		
GPS co-ordinate:	S	E
Comments / notes		

Co-ordinates as lat/long (e.g. 29°30'25" S / 30°45'10" E) **OR** as decimal degrees (e.g. 29.50694°S/30.75277°E)

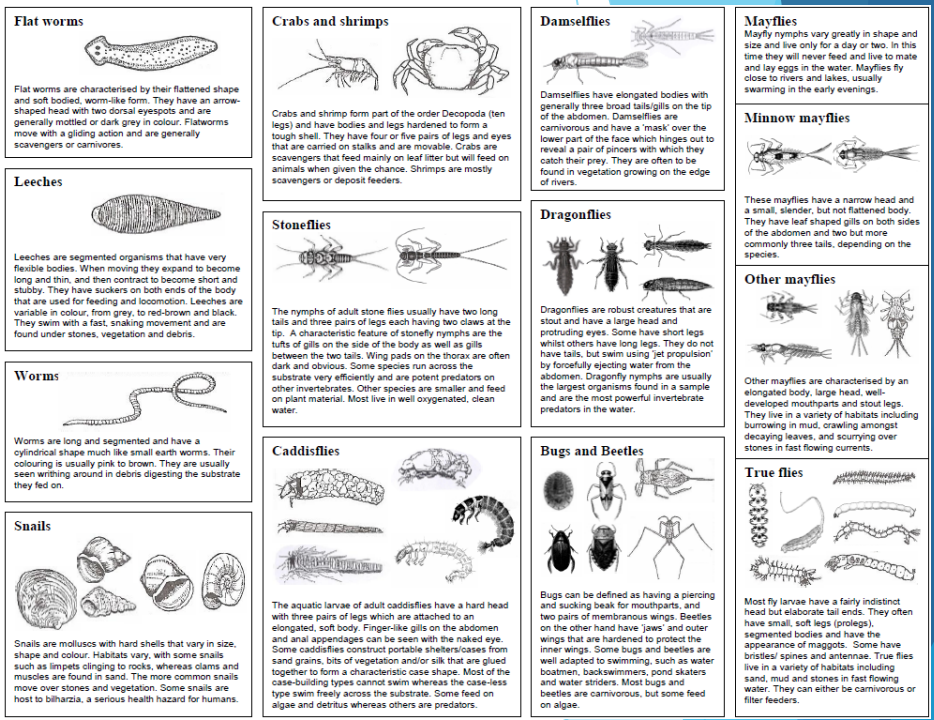
Scoring

1. On the table below, circle the sensitivity scores of the identified insects.
2. Add up all of the sensitivity scores.
3. Divide the total of the sensitivity score by the number of groups identified.
4. The result is the average score, which can be interpreted below.

GROUPS	SENSITIVITY SCORE
Flat worms	3
Worms	2
Leeches	2
Crabs or shrimps	6
Stoneflies	17
Minnow mayflies	5
Other mayflies	11
Damselflies	4
Dragonflies	6
Bugs or beetles	5
Caddisflies (cased & uncased)	9
True flies	2
Snails	4
TOTAL SCORE	
NUMBER OF GROUPS	
AVERAGE SCORE	
Average Score = Total Score ÷ Number of groups	

Interpretation of the miniSASS score: Although an ideal sample site has rocky, sandy, and vegetation habitats, not all habitats are always present at a site. If your river does not have rocky habitats use the sandy type category above to interpret your scores.

Ecological category (Condition)	River category	
	Sandy Type	Rocky Type
Unmodified (NATURAL condition)	> 6.9	> 7.9
Largely natural/few modifications (GOOD condition)	5.8 to 6.9	6.8 to 7.9
Moderately modified (FAIR condition)	4.9 to 5.8	6.1 to 6.8
Largely modified (POOR condition)	4.3 to 4.9	5.1 to 6.1
Seriously/critically modified (VERY POOR condition)	< 4.3	< 5.1



Clarity Tube

- A simplistic device to ‘measure’ the clarity, i.e. turbidity, of a grab sample.
- Initiative was motivated by community members in close proximity to a release pipe, that continuously felt sick as they used the insufficient treated effluents for domestic purposes.
- Monitoring is taking place twice daily and has been done so for the past 4 years.

Pho

Conclusion

- Need for mobile and continuous monito… …ate services are problematic.
- Water quality increasingly the… …cal well-being in the Southern…
- Water quality monit… …oaches that are complemen… …entional and citizen scien…
- Botto… …nables the capturing of loca… …demonstrating democracy build… …ent.
- Most co… …e region have adjusted to catchment-based m… …gement offering a landscape of formal and informal institutions as agents thus, offering an entry point for the inclusion of citizen science.

Citizen Science increases knowledge, data, empowerment, inclusiveness, sphere of influence and citizen learning / responsibility.

CWRR

Innovations in government, management and governance beyond what we know…

- Come and join us in having some great ideas!

Dr Sabine Stuart-Hill

Centre for Water Resources Research (CWRR)

Stuart-Hills@ukzn.ac.za

033 260 5460