Mara River Research:

a short synthesis of 7 years of our research

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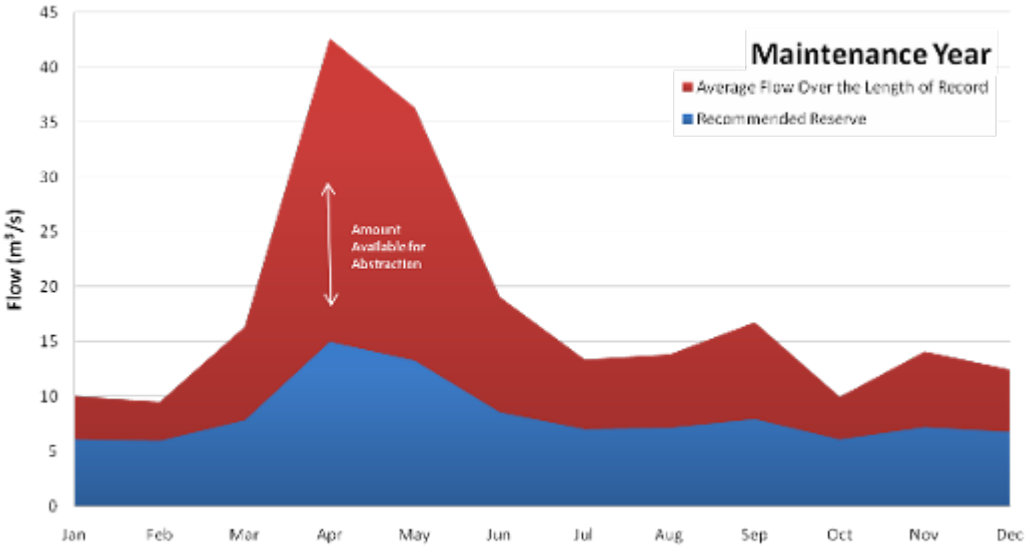
NATIONAL MUSEUMS OF KENYA
WHERE HERITAGE LIVES ON

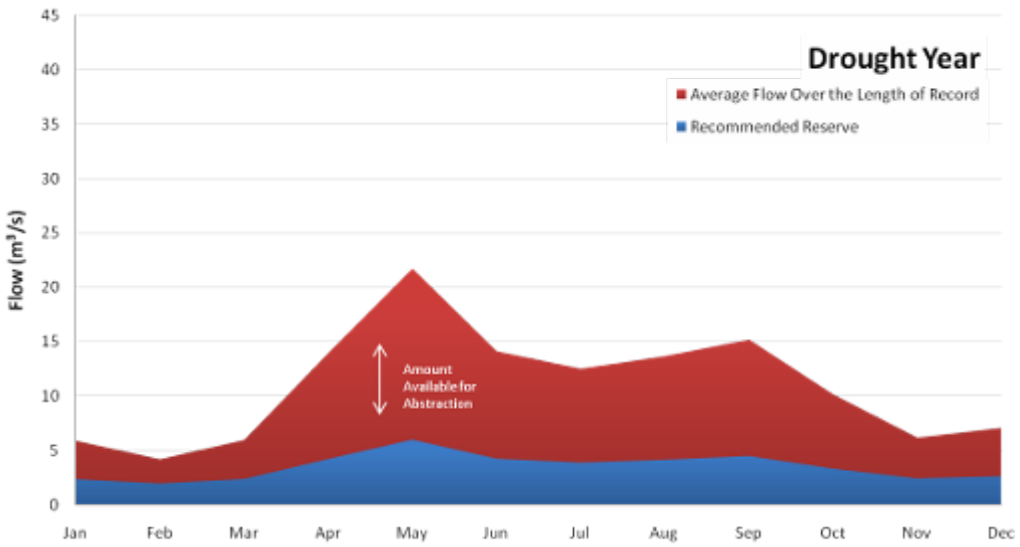
Cary Institute of Ecosystem Studies

Past Research

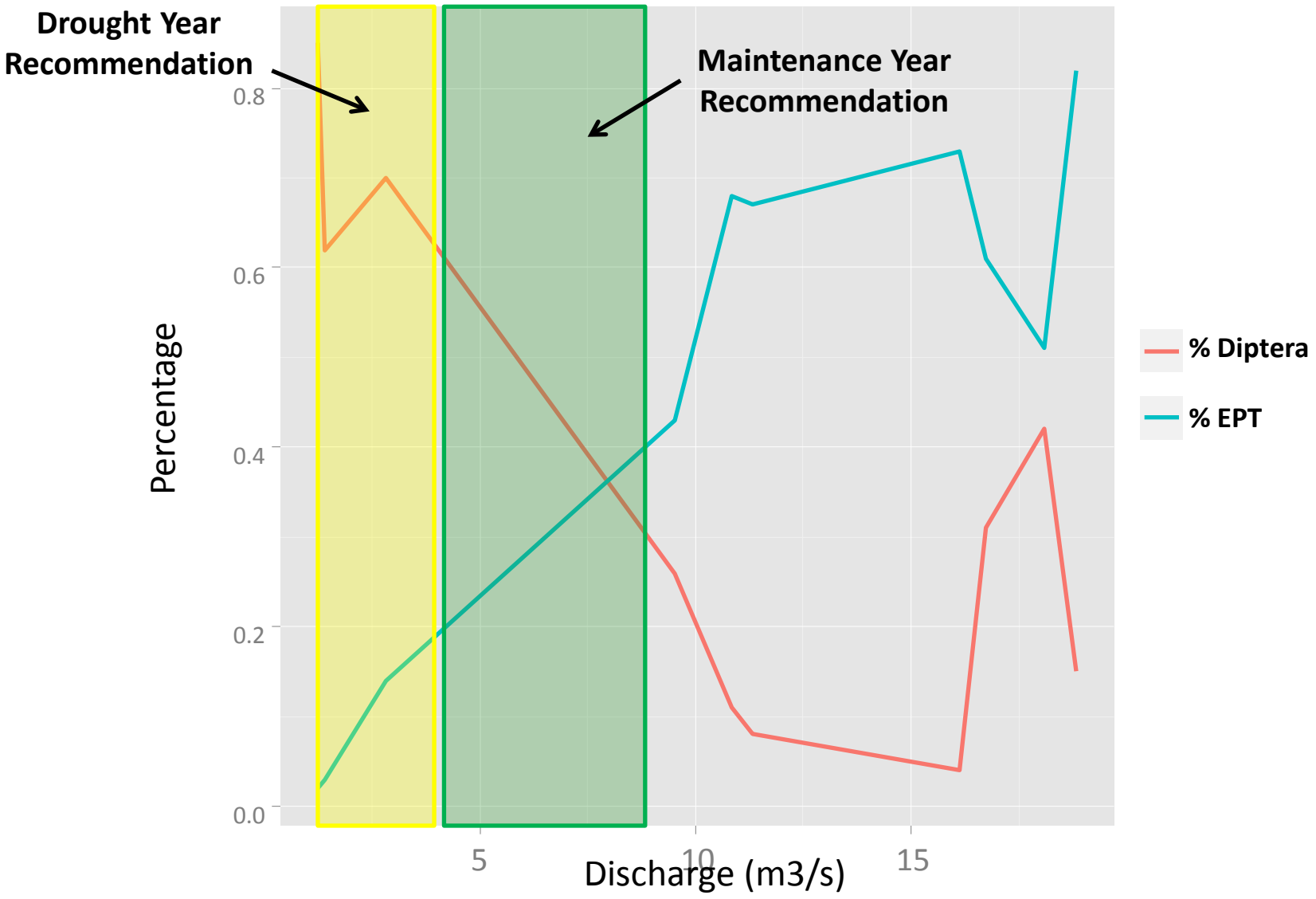
- Environmental Flow Assessment
  - Assisted with the determination of the minimum sustainable flow levels required for the Mara River to maintain proper ecosystem health
- Intensive aquatic macroinvertebrate sampling to refine the initial EFA assessment.
- Determination of the major sources of sediment in the basin.

Site 3: Historical Hydrograph and Environmental Flow Recommendations

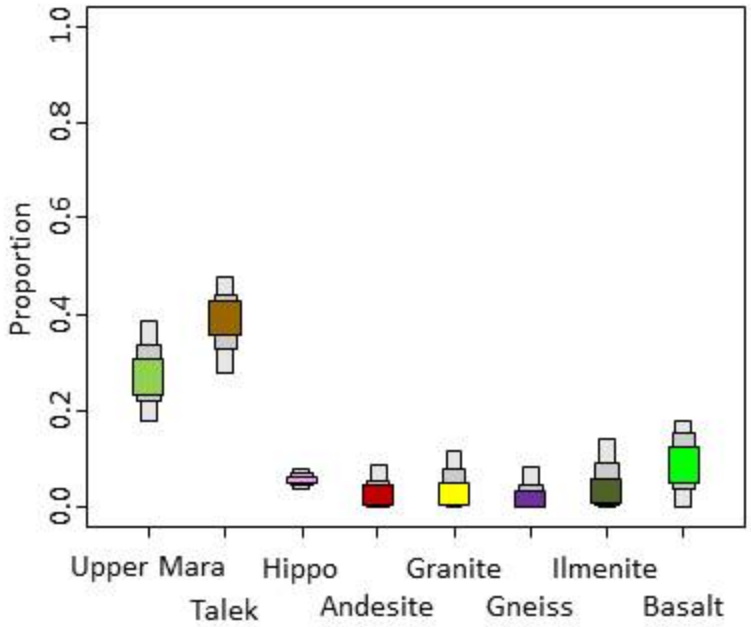


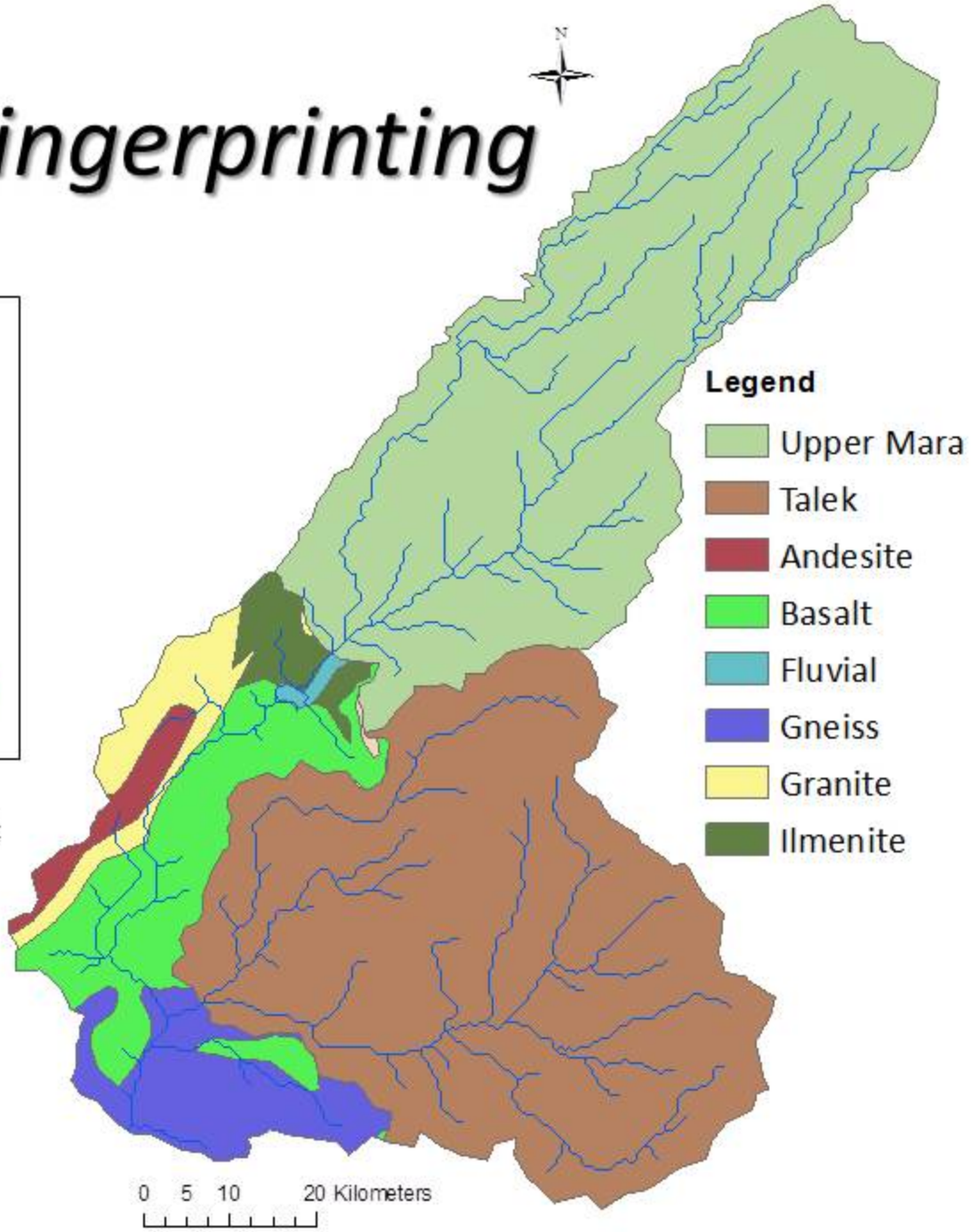


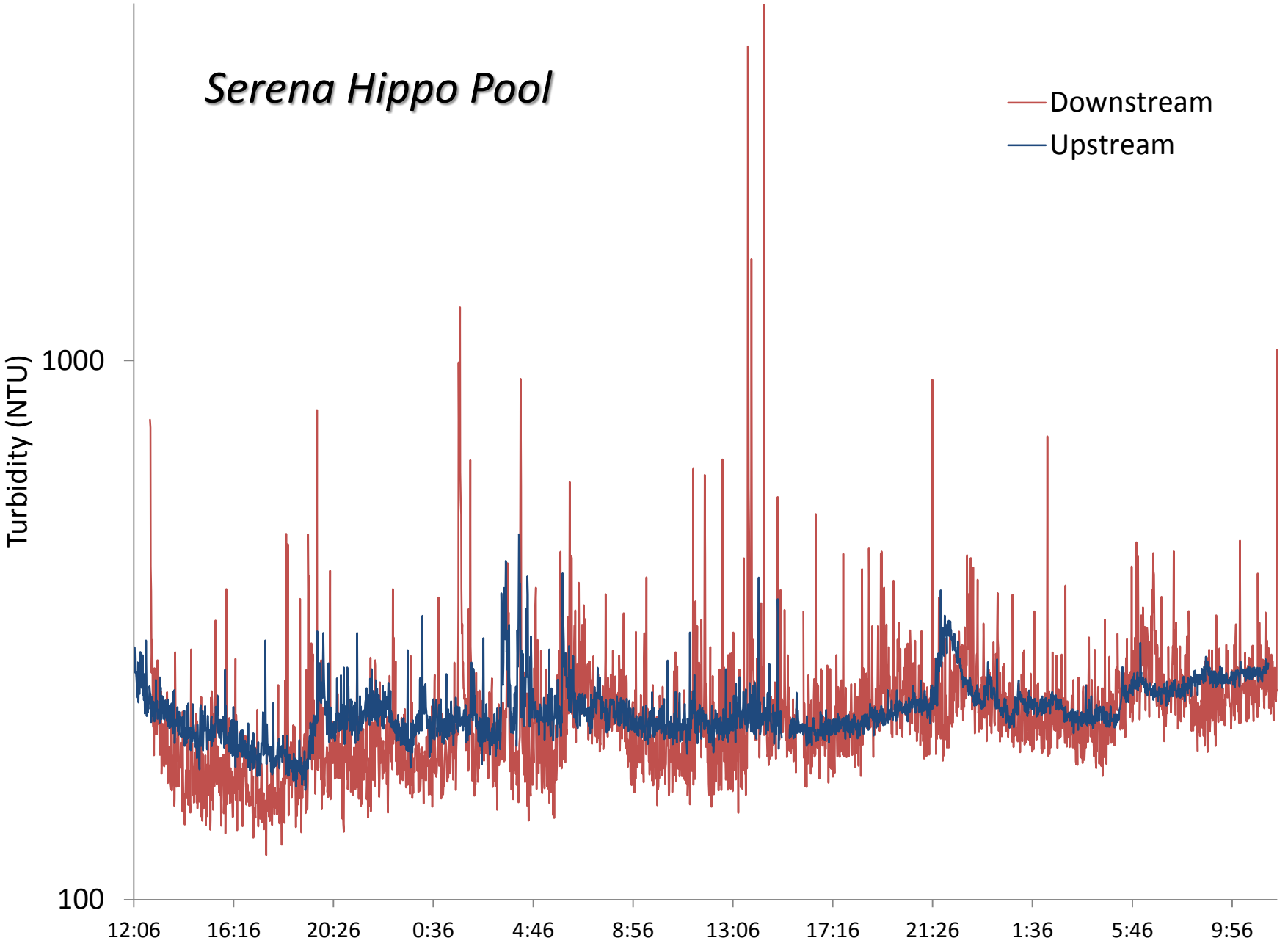
Site Three EFA Recommendations



Sediment Fingerprinting






Serena Hippo Pool
Downstream
Upstream
Turbidity (NTU)
1000
100
12:06
16:16
20:26
0:36
4:46
8:56
13:06
17:16
21:26
1:36
5:46
9:56

Current Research

Our current research seeks to determine

1) the magnitude, composition, and mineralization rate of inputs by hippos and wildebeest,
2) how these inputs influence nutrient limitation, bacterial and algal production, and whole-river metabolism and nutrient uptake, and how these effects vary with discharge,
3) the degree to which wildlife subsidies are incorporated into the river food web and how this varies with discharge, and
4) how animal inputs in the Mara relate to overall nutrient loadings and ecosystem function in the system.

Hippo Loading

= # hippos * % time in the river * amount of food consumed * energy content of food * assimilation efficiency

4,134	~12hours/day	DMI = 35 * $BM^{0.75}$	41.2% C, 2.8% N, 0.3% P	44% C; 100% N, P
Kanga et al. 2011	*Game camera photos*	*Clauss et al. 2004, 2007* *Schwarm et al. 2006*	*Field samples*	*Zoo study, literature*

Total excretion/egestion =
8,388 kg DM
3,202 kg C
492 kg N
48 kg P
per day!

Subalusky et al. 2014, Fresh. Biol.

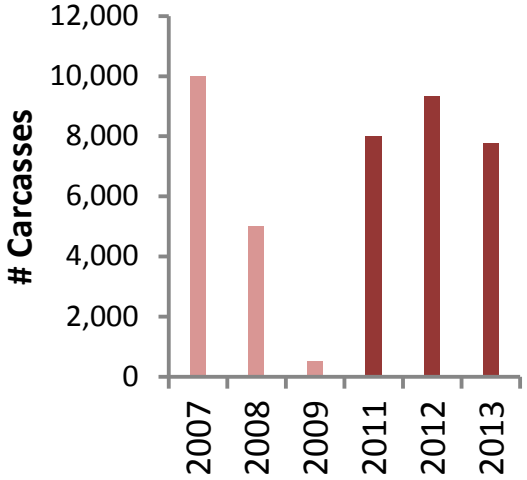
Wildebeest Loading

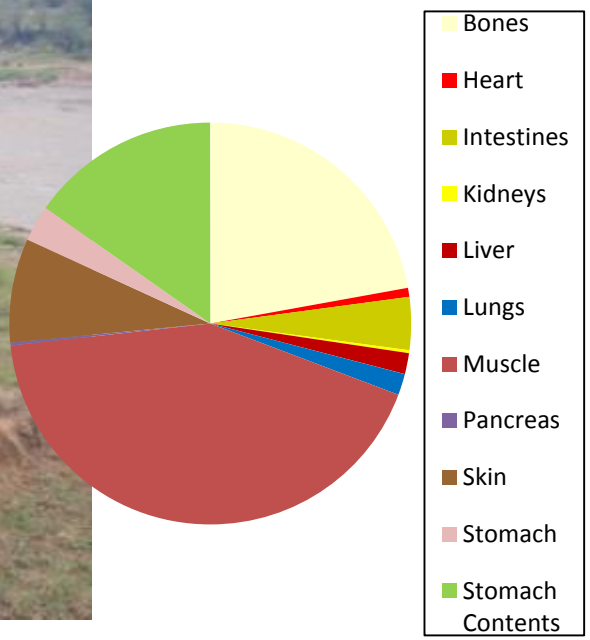
= # carcasses * carcass mass * carcass stoichiometry

6,766 carcasses/year

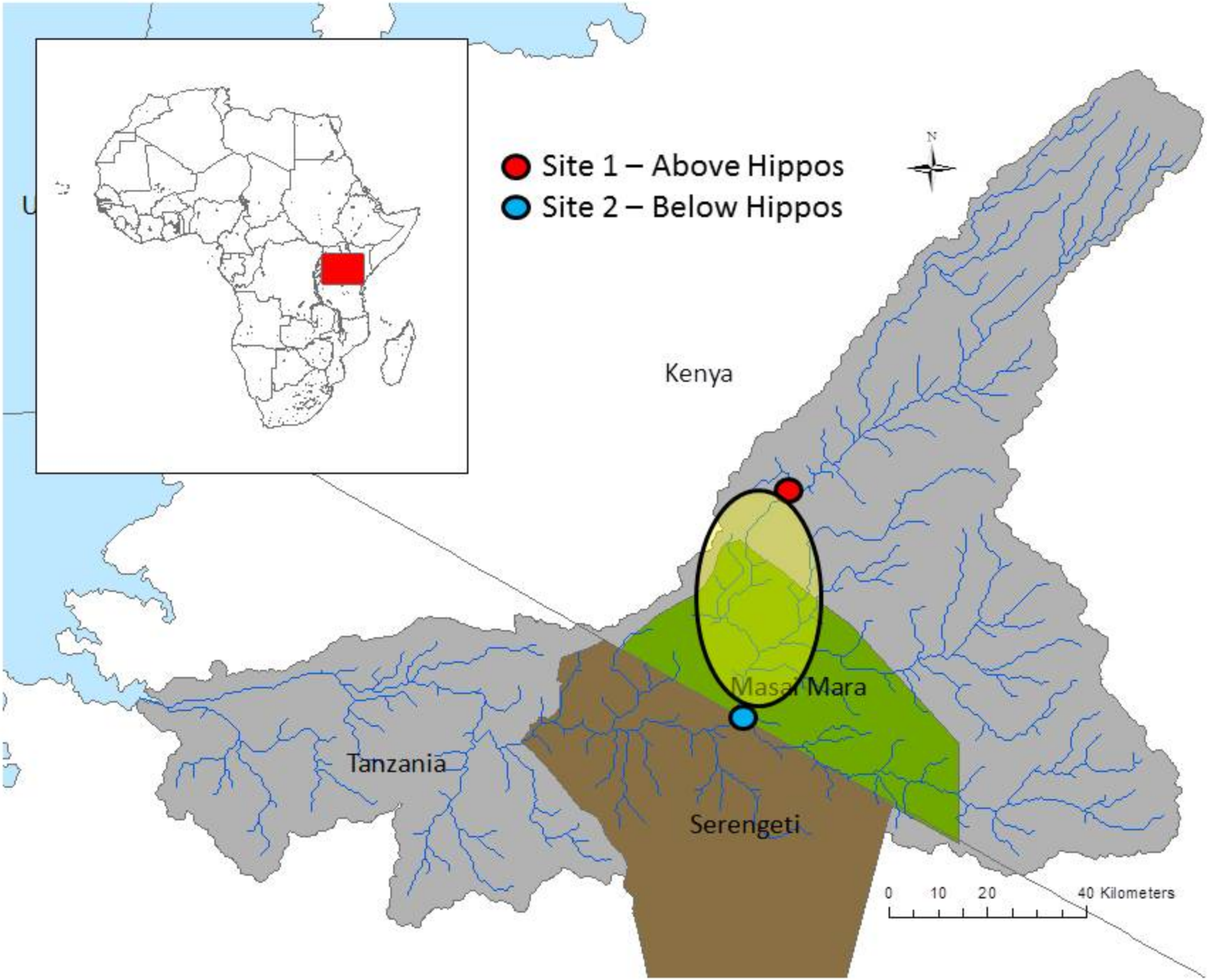
150 kg

40.5% C, 8.6% N, 2.0% P

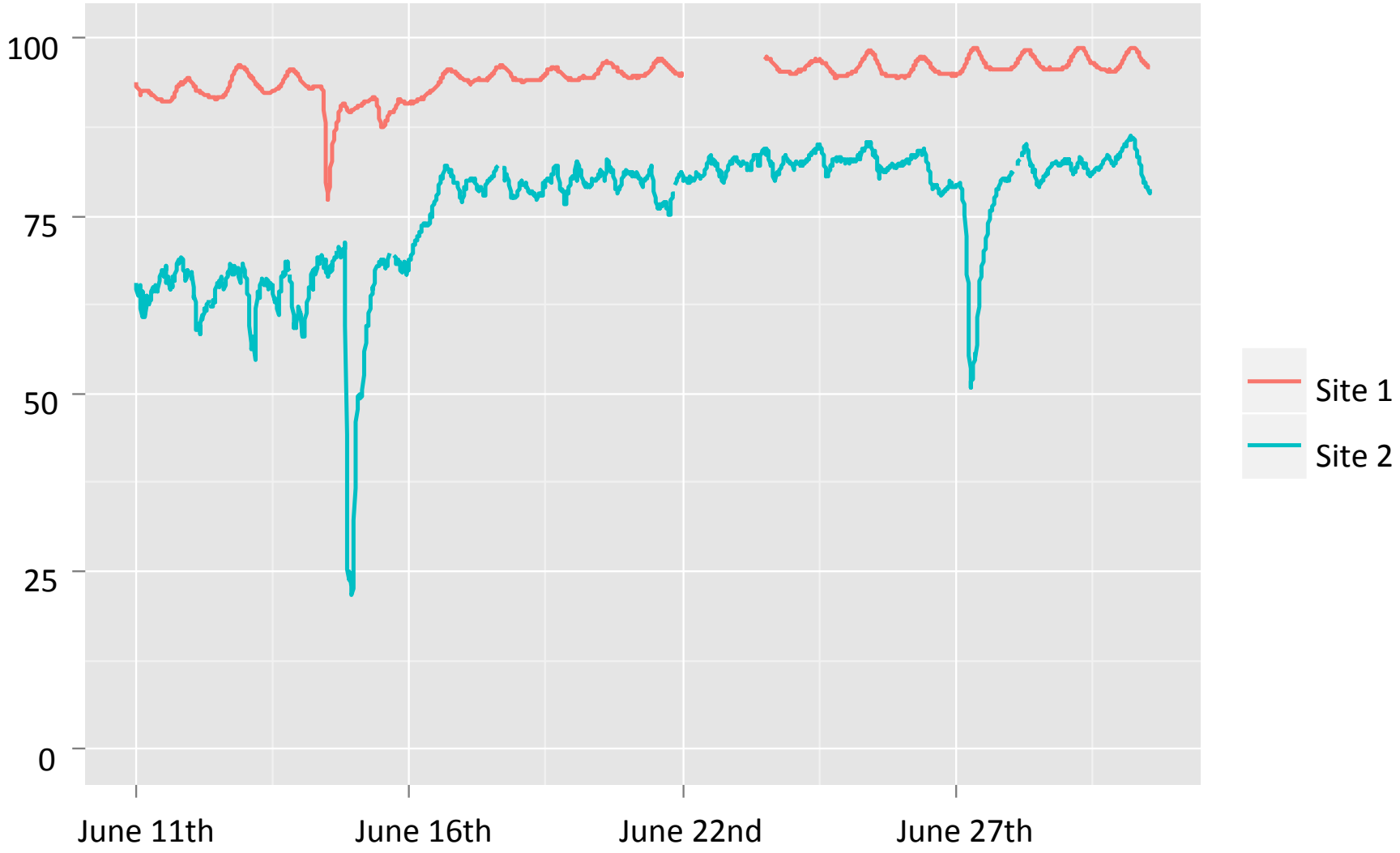




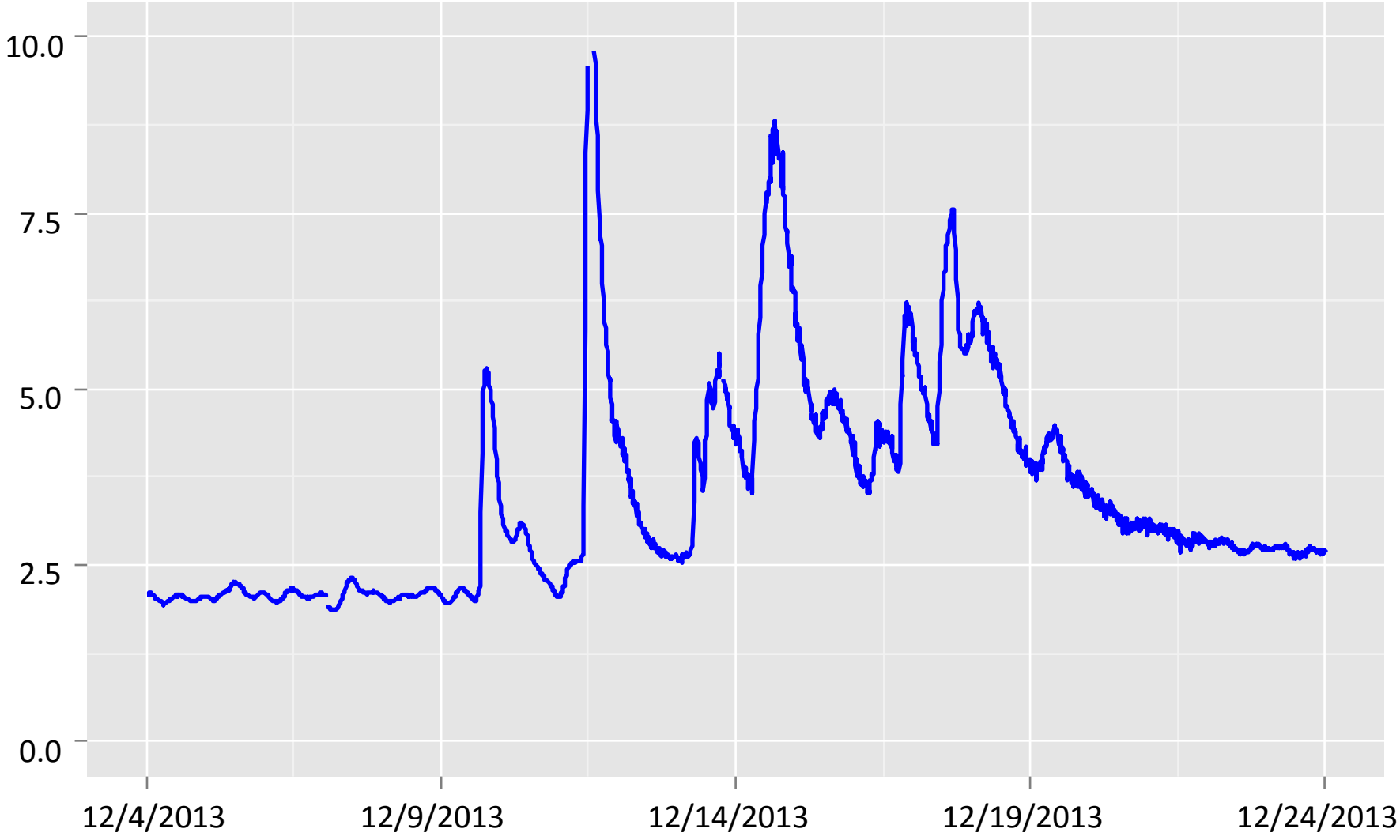
Total input = 411,035 kg C, 87,280 kg N, and 20,300 kg P every year


Site 1 – Above Hippos
Site 2 – Below Hippos
N
Kenya
Masai Mara
Tanzania
Serengeti
0 10 20 40 Kilometers

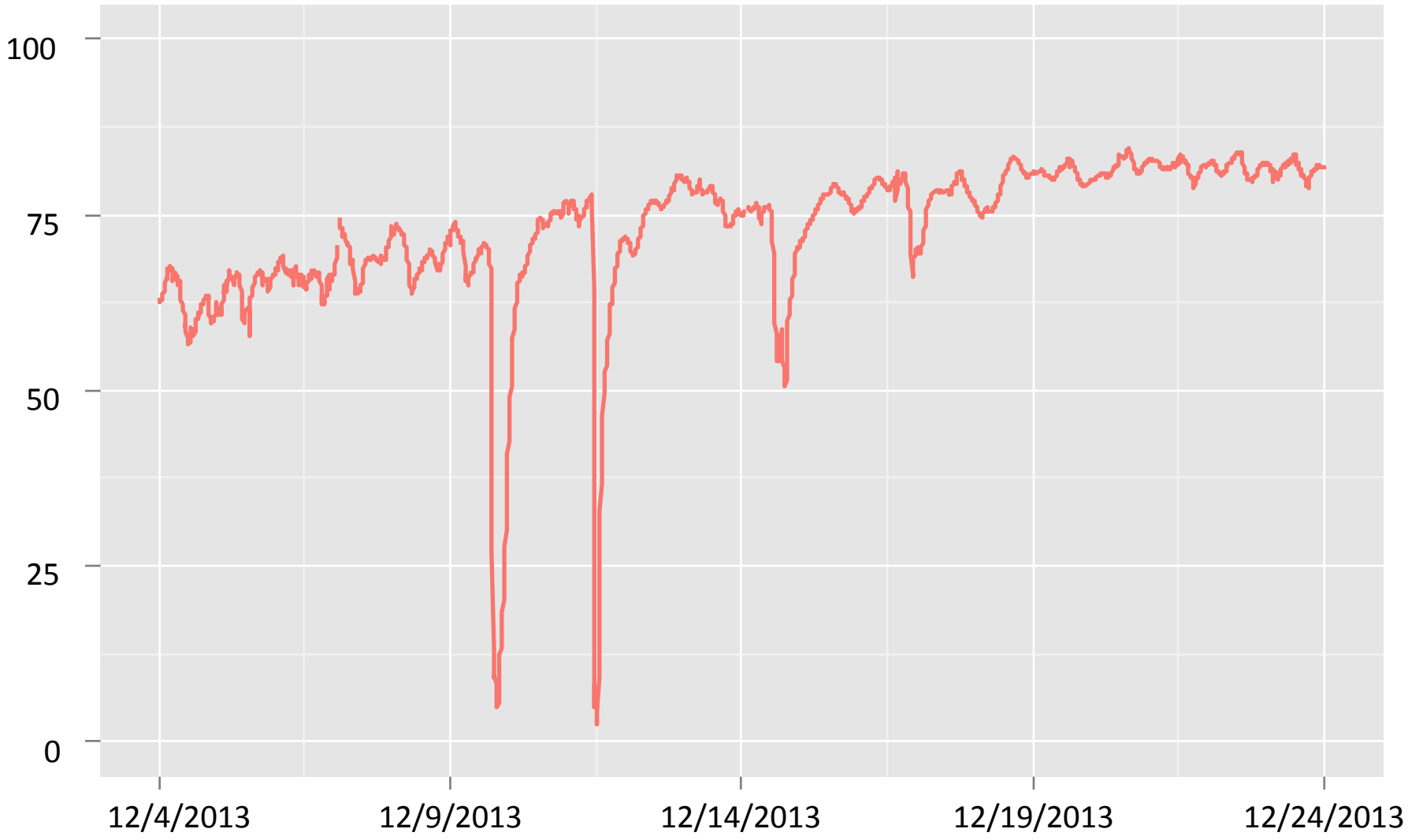
Dissolved Oxygen (%) – 20 Days

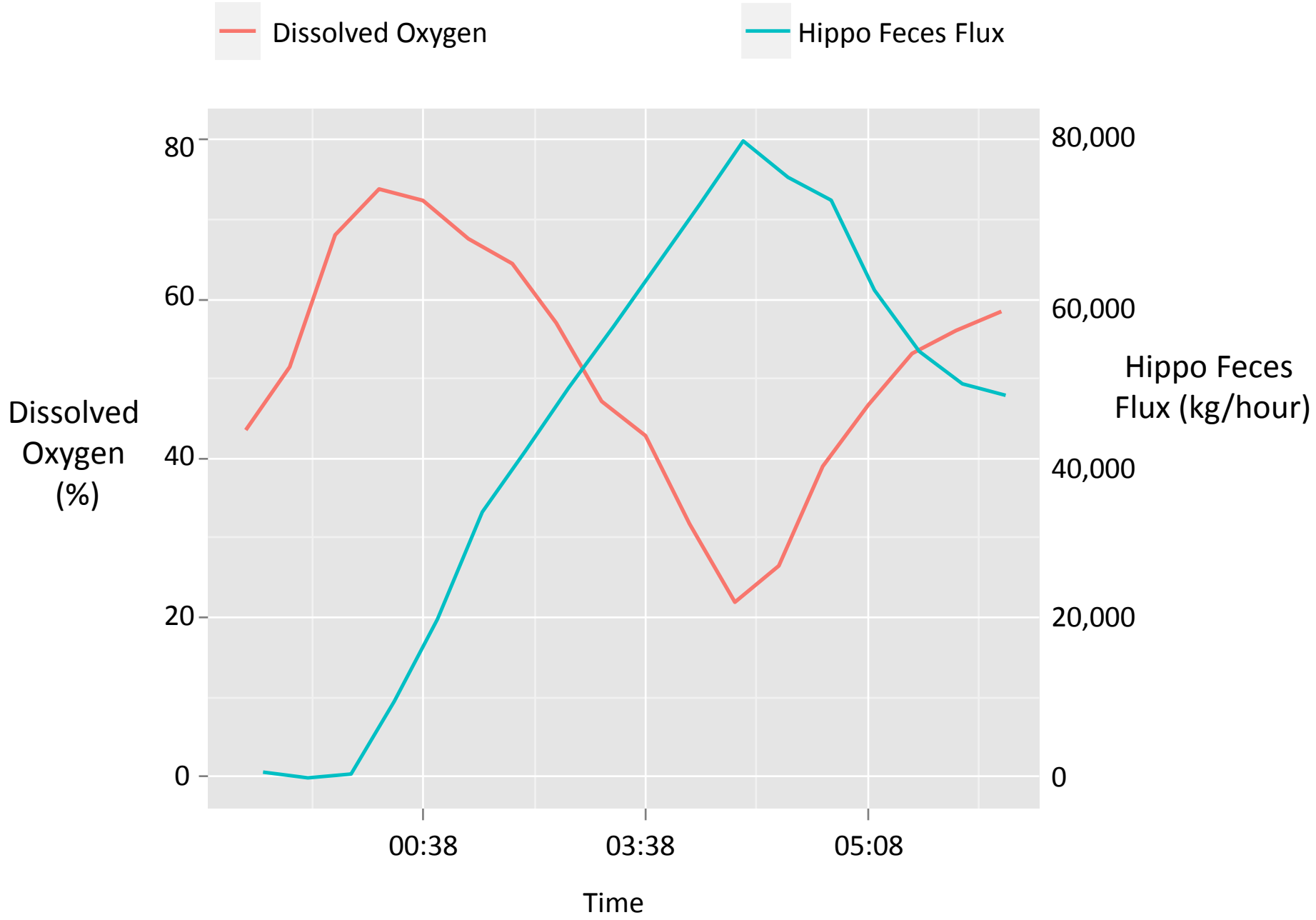


Site 2 – Depth (feet) – 20 Days



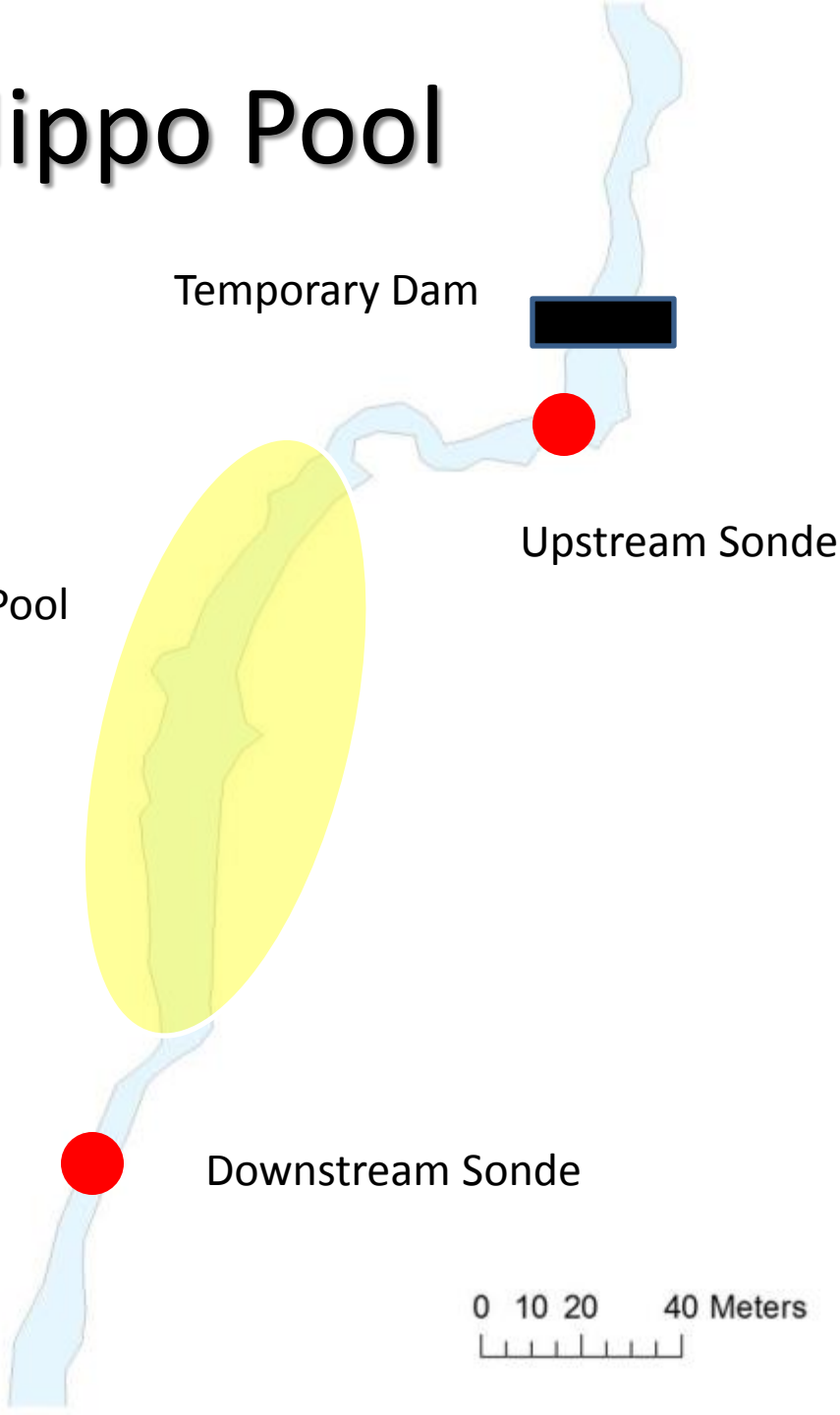
Site 2 - Dissolved Oxygen (%) – 20 Days

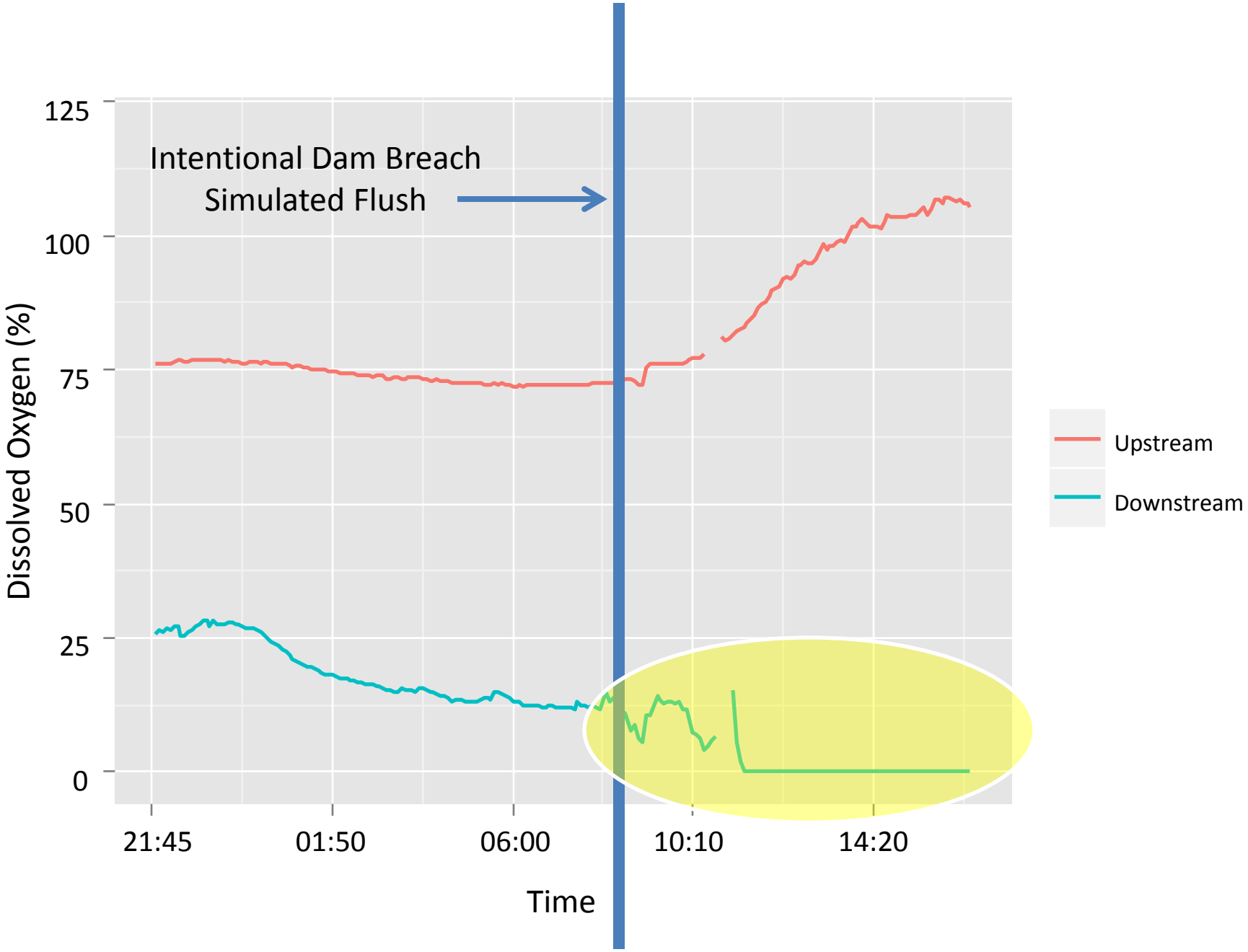



Dissolved Oxygen
Hippo Feces Flux
Dissolved Oxygen (%)
80
60
40
20
0
80,000
60,000
40,000
20,000
0
Hippo Feces Flux (kg/hour)
00:38
03:38
05:08
Time


ISCO
3700

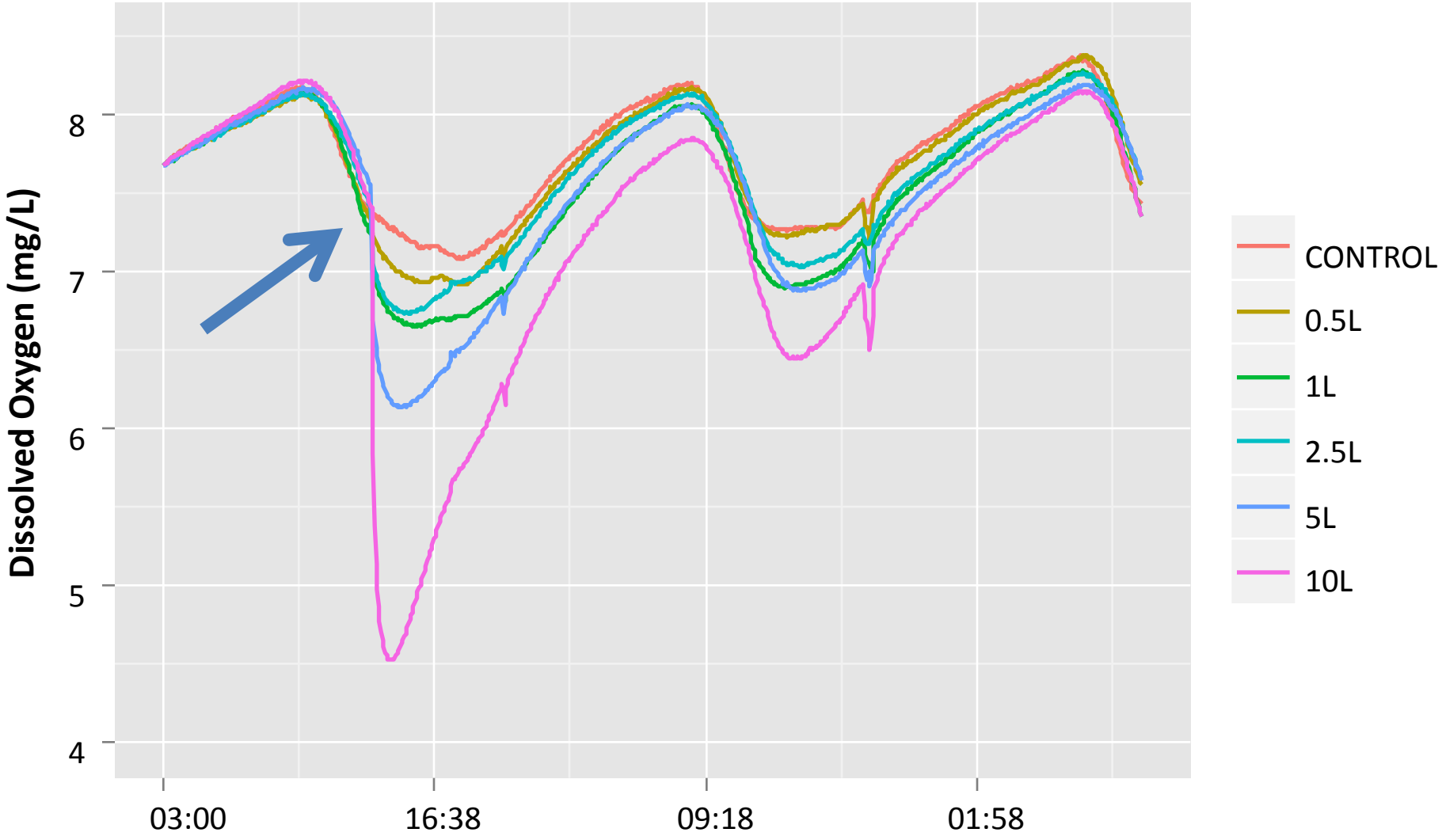
Ntiaktiak Hippo Pool



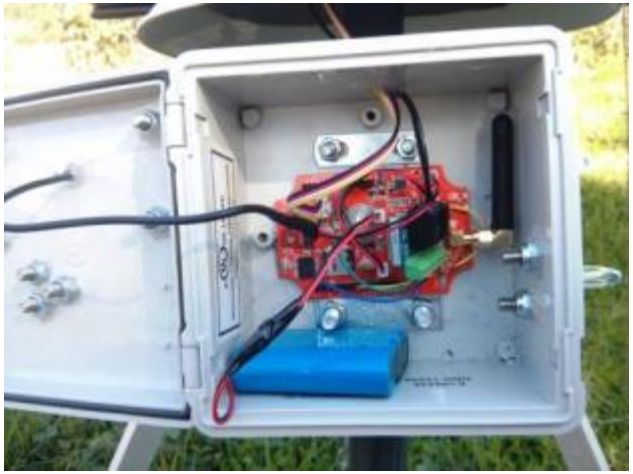

Intentional Dam Breach
Simulated Flush
125
100
75
50
25
0
Dissolved Oxygen (%)
21:45
01:50
06:00
10:10
14:20
Time
Upstream
Downstream

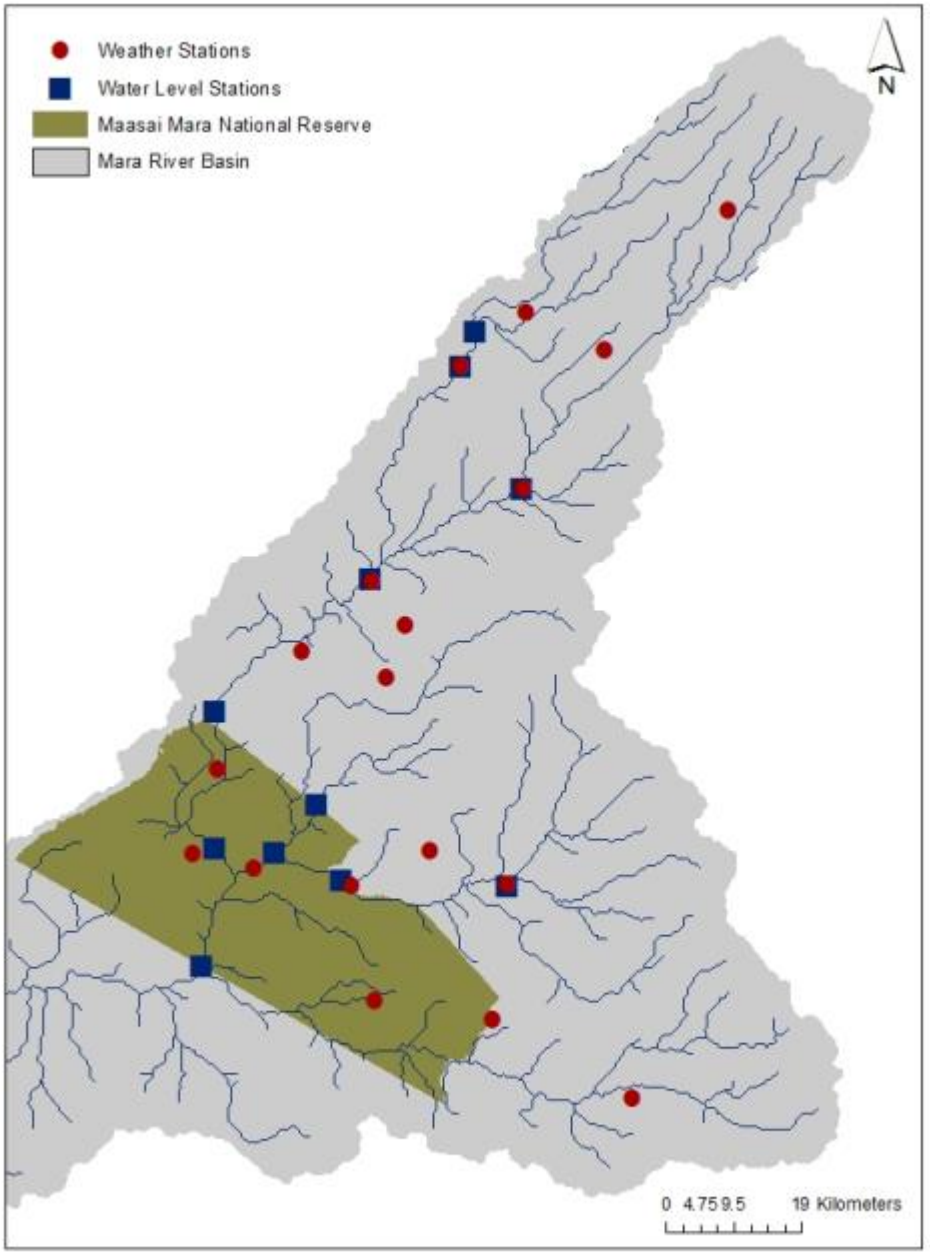
Portable Experimental Stream Array

Blackwater – Stream Addition



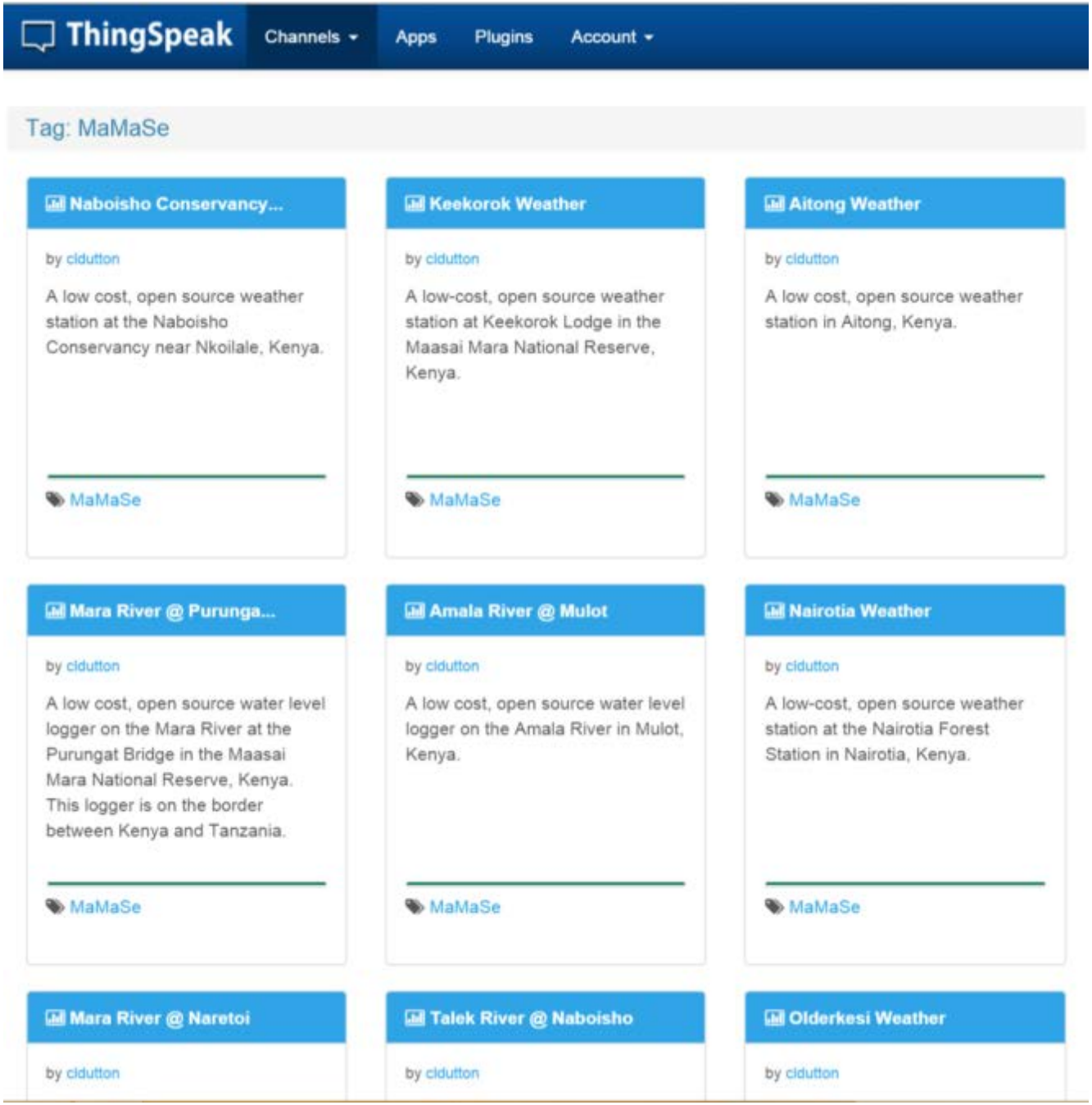
35 networked stations to track the movement of water in the basin
Less than $10,000 USD.



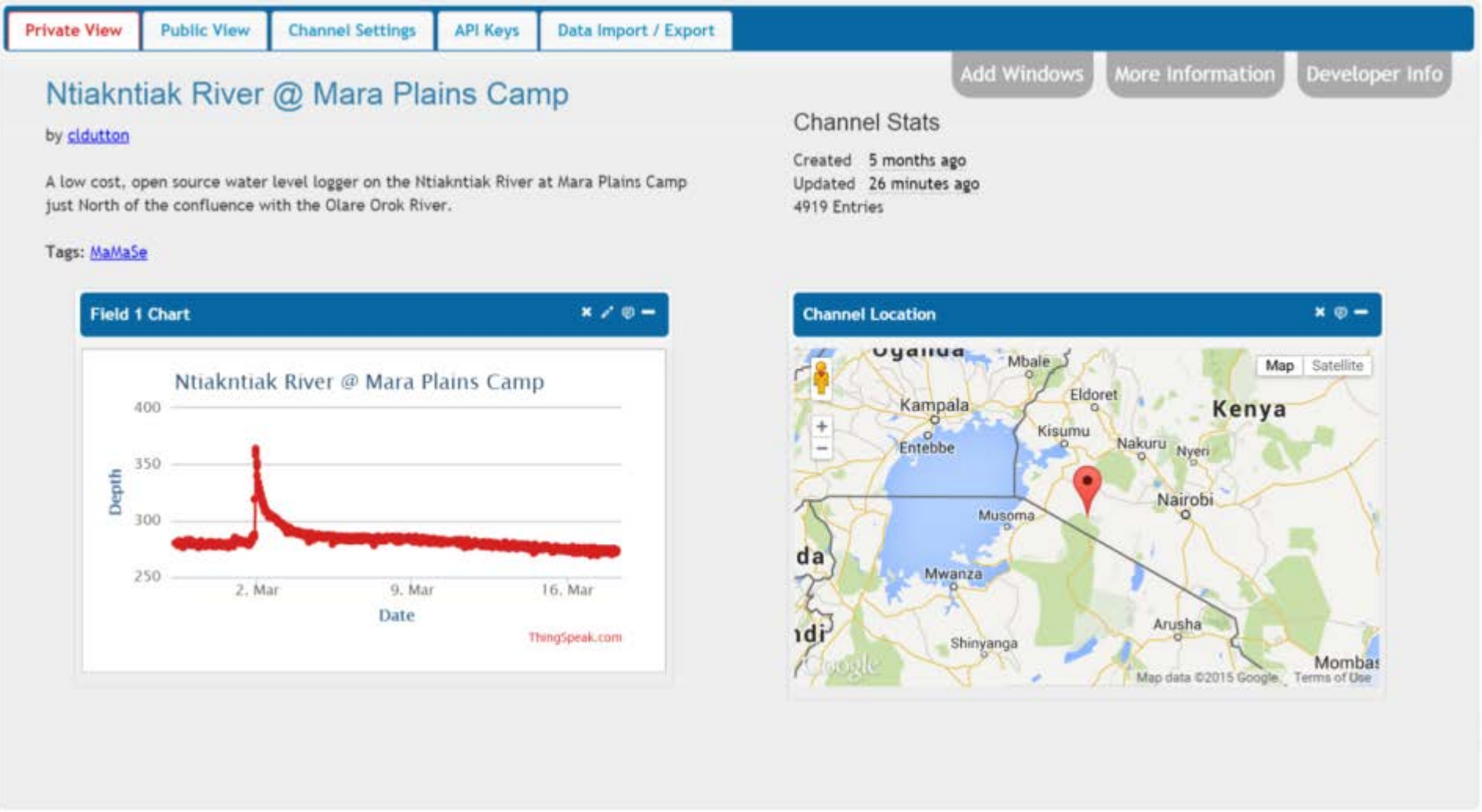


Weather Station

- Rainfall
- Air Temperature
- Barometric Pressure
- Humidity
- Soil Temperature
- Soil Moisture


ThingSpeak
Channels
Apps
Plugins
Account
Tag: MaMaSe
Naboisho Conservancy...
by cldutton
A low cost, open source weather station at the Naboisho Conservancy near Nkoilale, Kenya.
MaMaSe
Keekorok Weather
by cldutton
A low-cost, open source weather station at Keekorok Lodge in the Maasai Mara National Reserve, Kenya.
MaMaSe
Aitong Weather
by cldutton
A low cost, open source weather station in Aitong, Kenya.
MaMaSe
Mara River @ Purunga...
by cldutton
A low cost, open source water level logger on the Mara River at the Purungat Bridge in the Maasai Mara National Reserve, Kenya. This logger is on the border between Kenya and Tanzania.
MaMaSe
Amala River @ Mulot
by cldutton
A low cost, open source water level logger on the Amala River in Mulot, Kenya.
MaMaSe
Nairotia Weather
by cldutton
A low-cost, open source weather station at the Nairotia Forest Station in Nairotia, Kenya.
MaMaSe
Mara River @ Naretoi
by cldutton
Talek River @ Naboisho
by cldutton
Olderkesi Weather
by cldutton

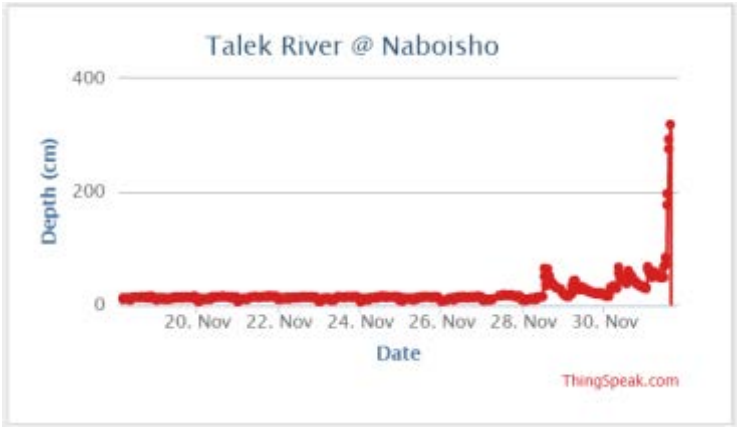
www.thingspeak.com

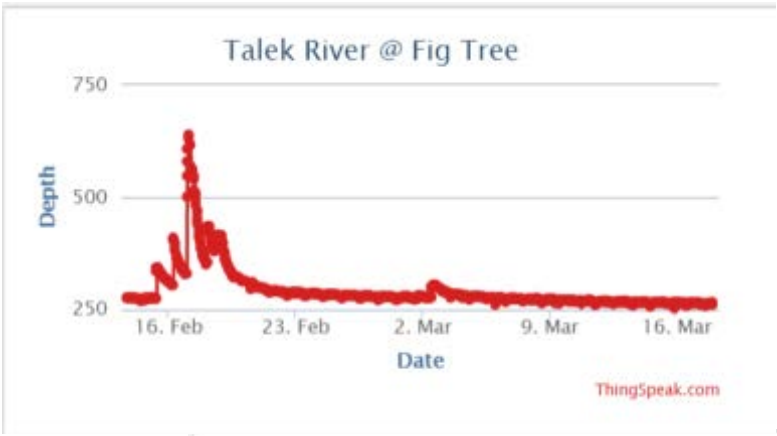


Change in the Serengeti-Mara Ecosystem
Water

- Unpredictable rainfall (no longer bi-modal)
- Increasing hippo population (=more loading)
- Declining water quantity and quality in rivers
- Increases in untreated human sewage
- Increases in erosion and loss of topsoil
- Declining forage for wildlife during dry seasons

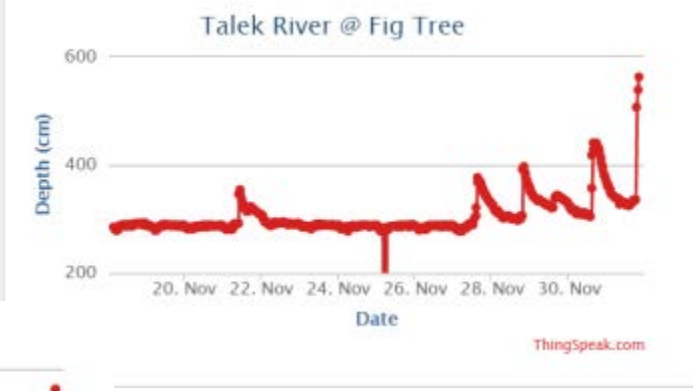
Very Flashy

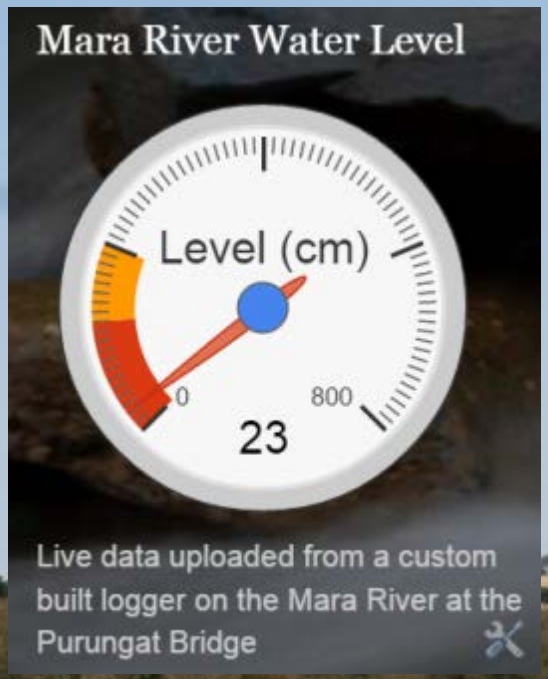

Talek River @ Naboisho
400
200
0
Depth (cm)
20. Nov
22. Nov
24. Nov
26. Nov
28. Nov
30. Nov
Date
ThingSpeak.com


Talek River @ Fig Tree
750
500
250
Depth
16. Feb
23. Feb
2. Mar
9. Mar
16. Mar
Date
ThingSpeak.com


Olare Orok River U/S of Talek
300
200
100
Depth (cm)
20. Nov
22. Nov
24. Nov
26. Nov
28. Nov
Date


Amala River @ Mulot
200
175
150
125
Depth
20. Nov
22. Nov
24. Nov
26. Nov
28. Nov
30. Nov
2. Dec
Date
ThingSpeak.com


Talek River @ Fig Tree
600
400
200
Depth (cm)
20. Nov
22. Nov
24. Nov
26. Nov
28. Nov
30. Nov
Date
ThingSpeak.com



= Cholera outbreak

2 dead, 61 cases as of March 20, 2015

Acknowledgements

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MRWUA
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The Dutch Government
MaMaSe Project
GLOWS
USAID/EA
USAID/Kenya
Governor's Camp
Rekero Camp
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UNESCO-IHE

For more information:

mara.yale.edu

maraadventure.blogspot.com