De-mystifying Geospatial Technology

A case study on capacity-building in GIS & GPS

Kibera (Nairobi) June - July 2010

IRC East Africa Regional Practitioners Workshop on Pro-Poor Urban Sanitation and Hygiene

Kigali, Rwanda, 29th-31st March 2011

Water Management MSc Project at Cranfield University (UK)
for Water and Sanitation for the Urban Poor (WSUP, Nairobi)

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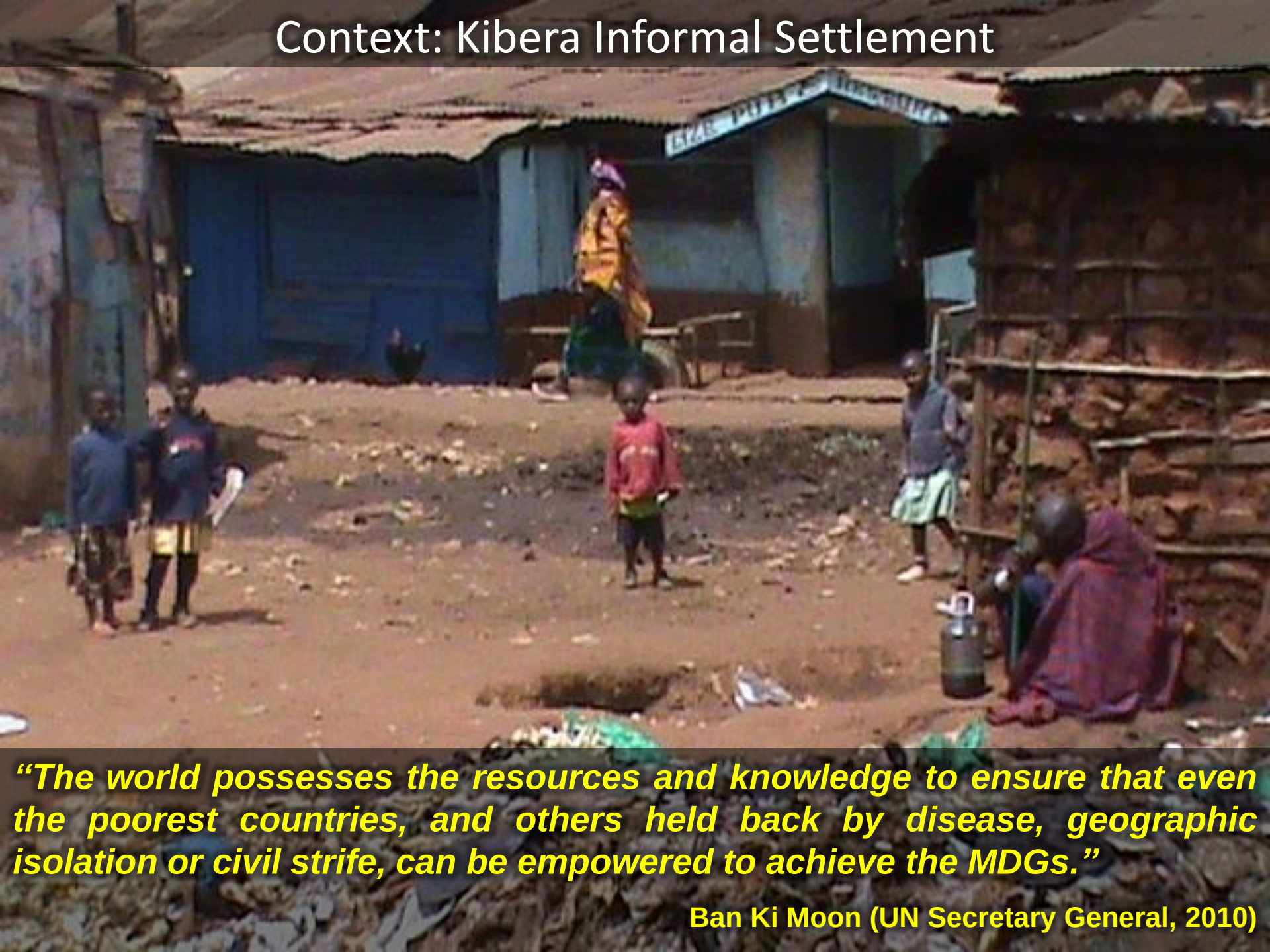
Context: Kibera Informal Settlement



"The world possesses the resources and knowledge to ensure that even the poorest countries, and others held back by disease, geographic isolation or civil strife, can be empowered to achieve the MDGs."

Ban Ki Moon (UN Secretary General, 2010)

Everything that happens...happens *somewhere*

This photo essay discusses **capacity-building** for **geographic information systems(GIS)** and **global positioning systems(GPS)** for technical and managerial level staff from *Nairobi City Water and Sewerage Company* (NCWSC), *Water Sanitation for the Urban Poor* (WSUP), and the *Umande Trust*. (Kibera Informal Settlements, Nairobi, Kenya: June – July 2010)GPS

Kibera Informal Settlement

Conditions:

- Shallow bed-rock and very high housing density mean domestic latrine pits are shallow and difficult to access for emptying
- Communal toilet blocks are being built – but still significant levels of open defecation and sewage
- Broken sewerage and water mains, and poor drainage spread disease
- Illegal, unregulated water connections make problems worse

Challenges:

- Locating municipal pipes for maintenance and improvement
- Locating leaks and illegal/unregulated connections
- Keeping track of water usage for planning and revenue purposes
- Updating existing maps to match what's on the ground

How can GIS & GPS help WASH Practitioners?

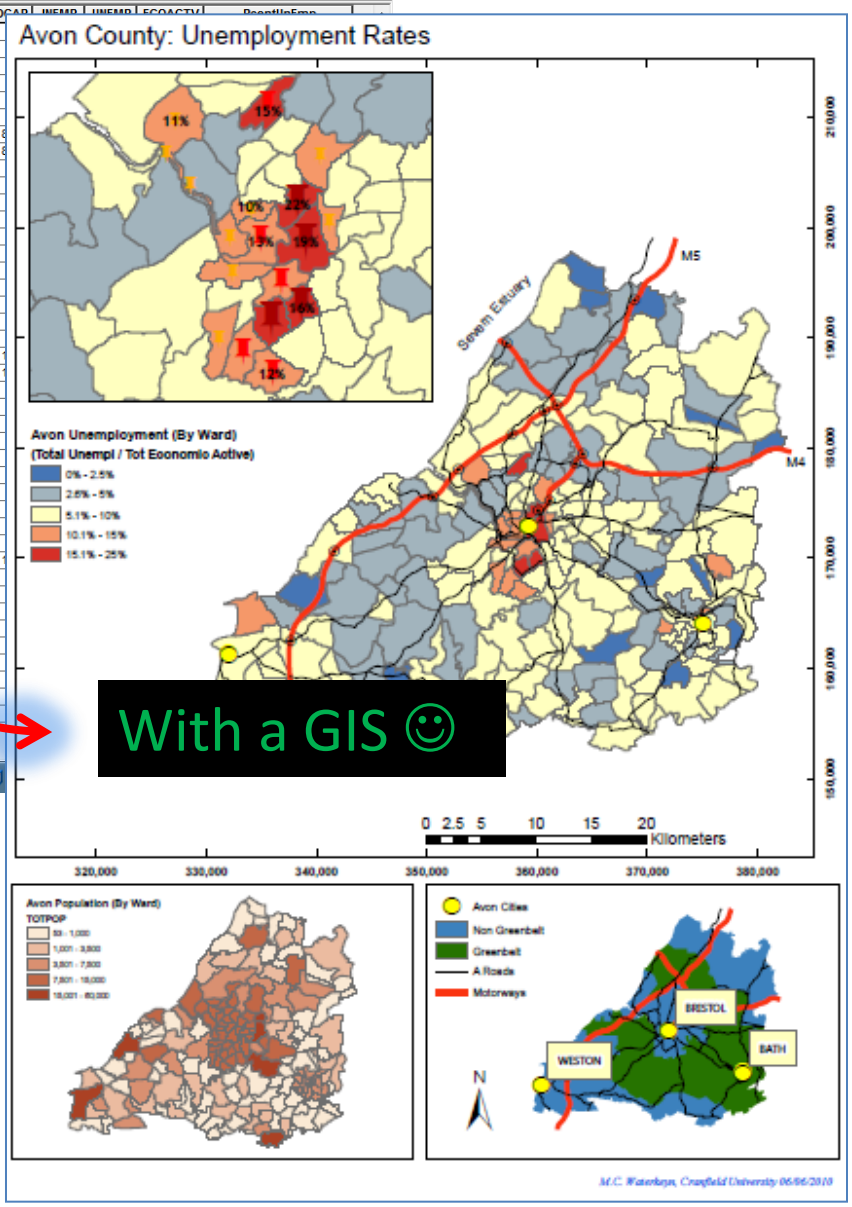
Attributes of Avon Unemployment (By Ward)

FID	Shape *	CLASS	AREA	PERIMETER	WPAREA	TOTPOP	AGE1624	AGE2534	AGE3544	AGE4565	AGE6675	AGEPLUS75	TOTHOUSE	OWNOCC	COUNCIL	NOCAR
0	Polygon	149	10.239	21.89	12.74	903	77	101	90	227	147	87	344	272	36	
1	Polygon	161	7.093	15.1	8.82	2483	239	379	315	509	350	148	875	825	15	
2	Polygon	165	5.659	13.26	7.04	3808	1083	504	382	523	377	157	966	476	164	
3	Polygon	167	4.857	13.15	6.04	164	16	27	22	27	21	9	55	26	9	
4	Polygon	179	0.003	0.21	18.42	4041	479	367	601	769	630	343	1492	1145	192	
5	Polygon	179	14.8	30.52	18.42	4041	479	367	601	769	630	343	1492	1145	192	
6	Polygon	0	0.021	0.62	18.42	56831	6669	6994	6326	10672	9365	5562	22486	14392	5188	
7	Polygon	176	21.21	30.72	26.39	56831	6669	6994	6326	10672	9365	5562	22486	14392	5188	
8	Polygon	146	20.18	29.18	25.11	3223	325	402	344	710	526	284	1093	833	188	
9	Polygon	163	9.862	20.14	12.27	1454	151	209	201	273	201	94	526	406	92	
10	Polygon	177	0.011	0.41	7.43	166	21	24	22	30	17	3	52	35	8	
11	Polygon	177	0.008	0.41	7.43	166	21	24	22	30	17	3	52	35	8	
12	Polygon	177	0.021	0.82	7.43	166	21	24	22	30	17	3	52	35	8	
13	Polygon	164	0.008	0.41	13.93	352	38	43	69	56	31	12	99	80	4	
14	Polygon	164	0.011	0.41	13.93	352	38	43	69	56	31	12	99	80	4	
15	Polygon	177	5.934	15.82	7.43	166	21	24	22	30	17	3	52	35	8	
16	Polygon	172	7.829	16.65	9.74	215	22	26	36	49	24	15	71	45	16	
17	Polygon	164	11.176	20.04	13.93	352	38	43	69	56	31	12	99	80	4	
18	Polygon	162	3.973	10.89	4.94	280	45	32	41	60	30	17	93	73	5	
19	Polygon	156	0.003	0.21	17.58	17899	2226	2931	2168	3082	2170	1459	6694	5043	705	
20	Polygon	156	14.125	25.48	17.58	17899	2226	2931	2168	3082	2170	1459	6694	5043	705	
21	Polygon								27	54	42	15	66	46	0	
22	Polygon								69	88	51	23	160	109	7	
23	Polygon								226	379	220	94	563	413	76	
24	Polygon								141	266	142	79	435	274	77	
25	Polygon								42	64	47	6	106	86	13	
26	Polygon								64	93	70	26	169	117	35	
27	Polygon	104	8.088	18.39	10.06	823	117	101	109	210	91	37	289	188	62	
28	Polygon	112	4.511	13.26	5.61	602	65	78	80	125	72	38	213	144	37	
29	Polygon	115	1.428	10.28	1.78	586	71	61	83	111	100	38	221	110	73	
30	Polygon	129	5.886	13.36	7.32	4504	477	893	590	696	461	200	1598	1204	328	
31	Polygon	128	10.268	20.35	12.77	18267	2483	2958	2274	3232	1982	976	6509	4561	1432	
32	Polygon	118	3.252	13.56	4.05	210	30	17	26	61	21	7	65	45	12	
33	Polygon	142	7.475	18.5	9.3	363	51	52	42	85	44	27	135	76	31	
34	Polygon	99	7.209	16.44	8.97	931	121	149	109	160	89	91	324	162	134	
35	Polygon	106	6.058	14.8	7.54	1460	176	188	244	308	126	69	500	363	112	
36	Polygon	137	10.173	20.45	12.66	1133	143	101	187	259	136	55	3[illegible]	284	67	
37	Polygon	122	0.003	0.21	10.74	329	45	38	44	86	21	21	106	57	20	
38	Polygon	102	4.58	11.82	5.7	134	14	21	15	23	21	8	42	36	0	
39	Polygon	122	0.013	0.51	10.74	329	45	38	44	86	21	21	106	[illegible]	20	
40	Polygon	117	4.743	16.54	5.9	1675	194	263	219	376	180	87	611	465	121	

Record: 1 Show: All Selected Records (0 out of 227 Selected) Options

Without a GIS ☹

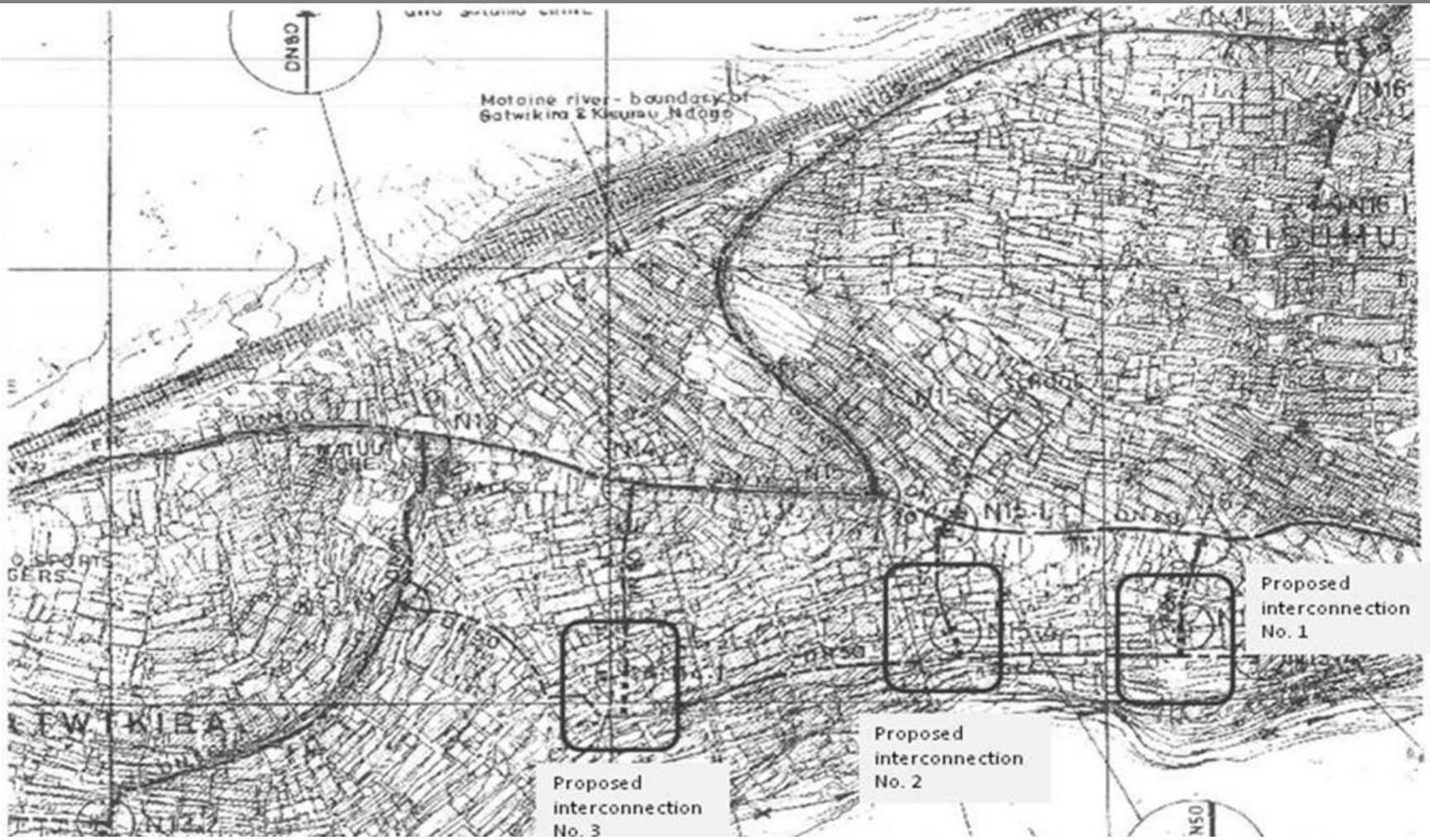
With a GIS ☺



- GIS (Geographical Information System) allows us to collect the key information and represent it as a map...
- GPS (Global Positioning System) is a very quick, and relatively accurate way to collect coordinates and to navigate in the field...

A picture (or a map) says a thousand words...

Pre-training Capacity:
Map used by WSUP, Umande & NCWSC (Nairobi Water) project staff in a Community Liaison Meeting

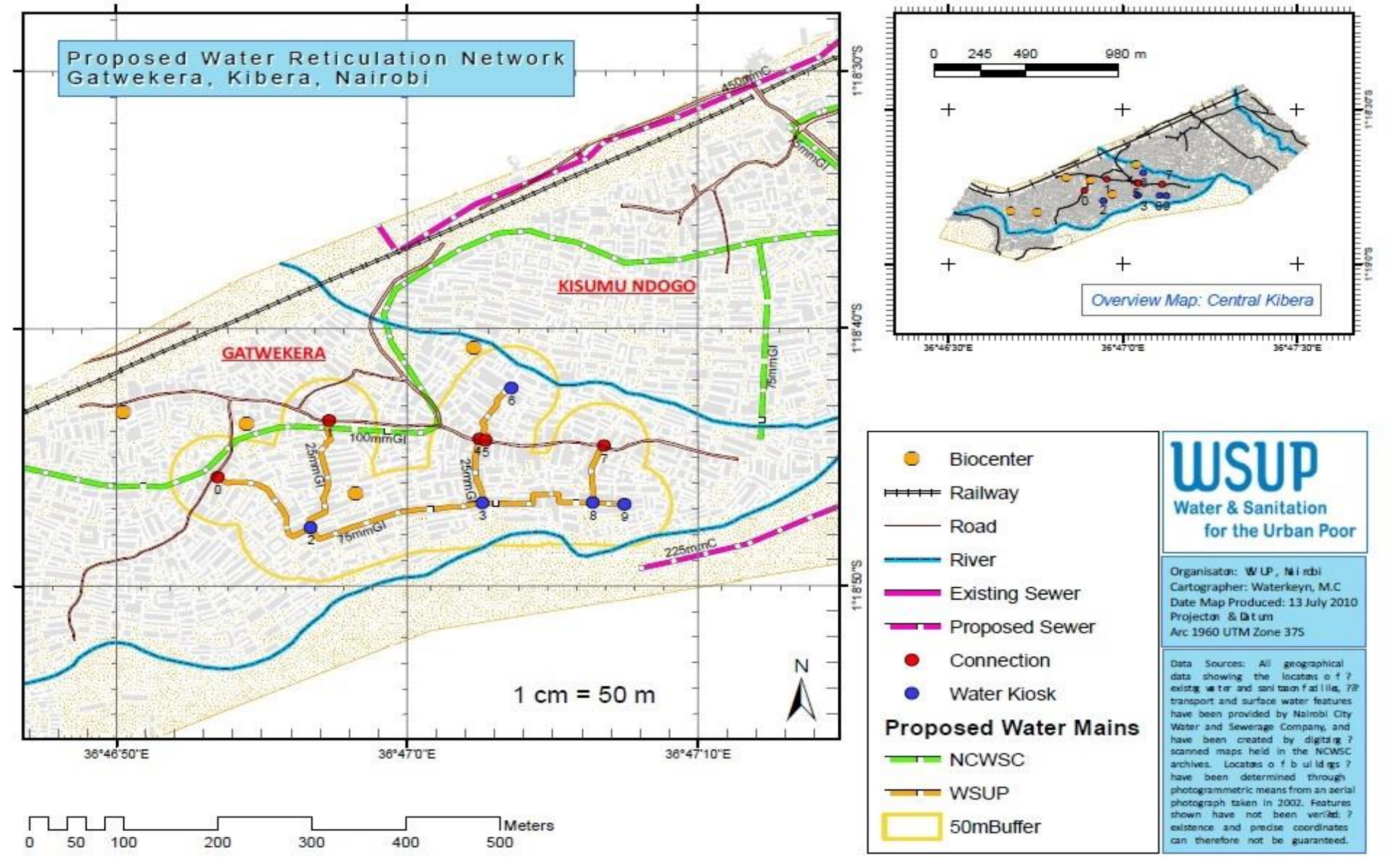


Proposed pipe layout on a traditional map of the township: no scale, legend and few labels of existing and proposed features. This poor quality and out of date map misses all the key features needed to orientate the reader, to accurately locate features. It does not illustrate the proposed WASH scheme clearly.

Capacity building for GIS & GPS will help the project WASH staff to create and update new maps that clearly illustrate any proposed WASH project.

Target Mapping Capacity:

To create a clear map of existing and proposed infrastructure –archive data is used from the NCWSC database with ArcGIS software. This is geo-referenced with satellite images from Google Earth and new GPS data collected on-site with basic hand-held GPS devices.



Mapping Capacity Building Workshop:

Training was carried out in one intensive week. It included an overview of GIS & GPS applications and limitations; class demonstrations and tutorials in ArcGIS specifically on a current WASH project; as well as learning how to collect and verify GPS data collected on a site visit to Kibera.

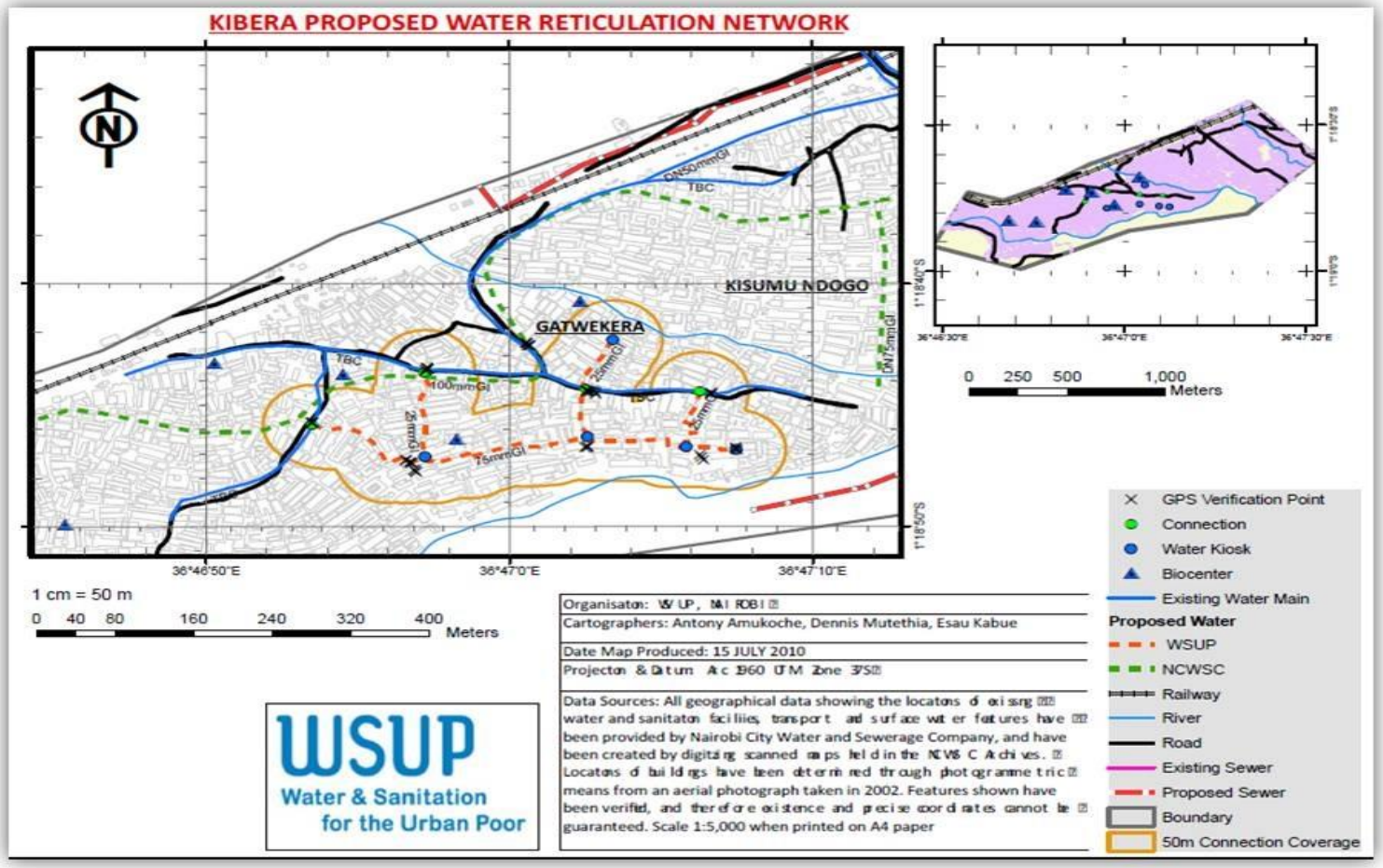
Participants were 19 WASH practitioners from Nairobi Water (NCWSC), the Umande Trust, and Water and Sanitation for the Urban Poor (WSUP) including civil engineers, field technicians, surveyors, project managers and sociologists. They worked in groups to share ideas (and laptops!).

Training Programme:

GIS Capacity Building Workshop Timetable						
Location:		Conference Centre [Hotel]	Conference Centre [Hotel]	Site [Kibera]	Conference Centre [Hotel]	NCWSC and Umande Offices
Start-Finish	Day:	Monday	Tuesday	Wednesday	Thursday	Friday
09.00hrs-10.30hrs	Session 1	Intro Presentation: Fundamentals of GIS and GPS	Tutorial 3: Georeferencing Images & Error Checking	[Site Visit] GPS Navigation	Workshop: Site Data Input & Consolidation and Extension Exercise	Trouble-shooting Session [Umande Office]
10.30hrs-12.30hrs	Session 2	Tutorial 1: Data Management in ArcCatalogue		[Site Visit]: GPS Surveying		
Lunch						
13.30hrs-15.00hrs	Session 3	Tutorial 2: Map Making in ArcMap	Tutorial 4: Adding Data Layers, Digitizing Images & Buffer Zones	Private study/ office work	Individual map preparations	Trouble-shooting Session [NCWSC Office]
15.00hrs-17.30hrs	Session 4				Group feedback session	

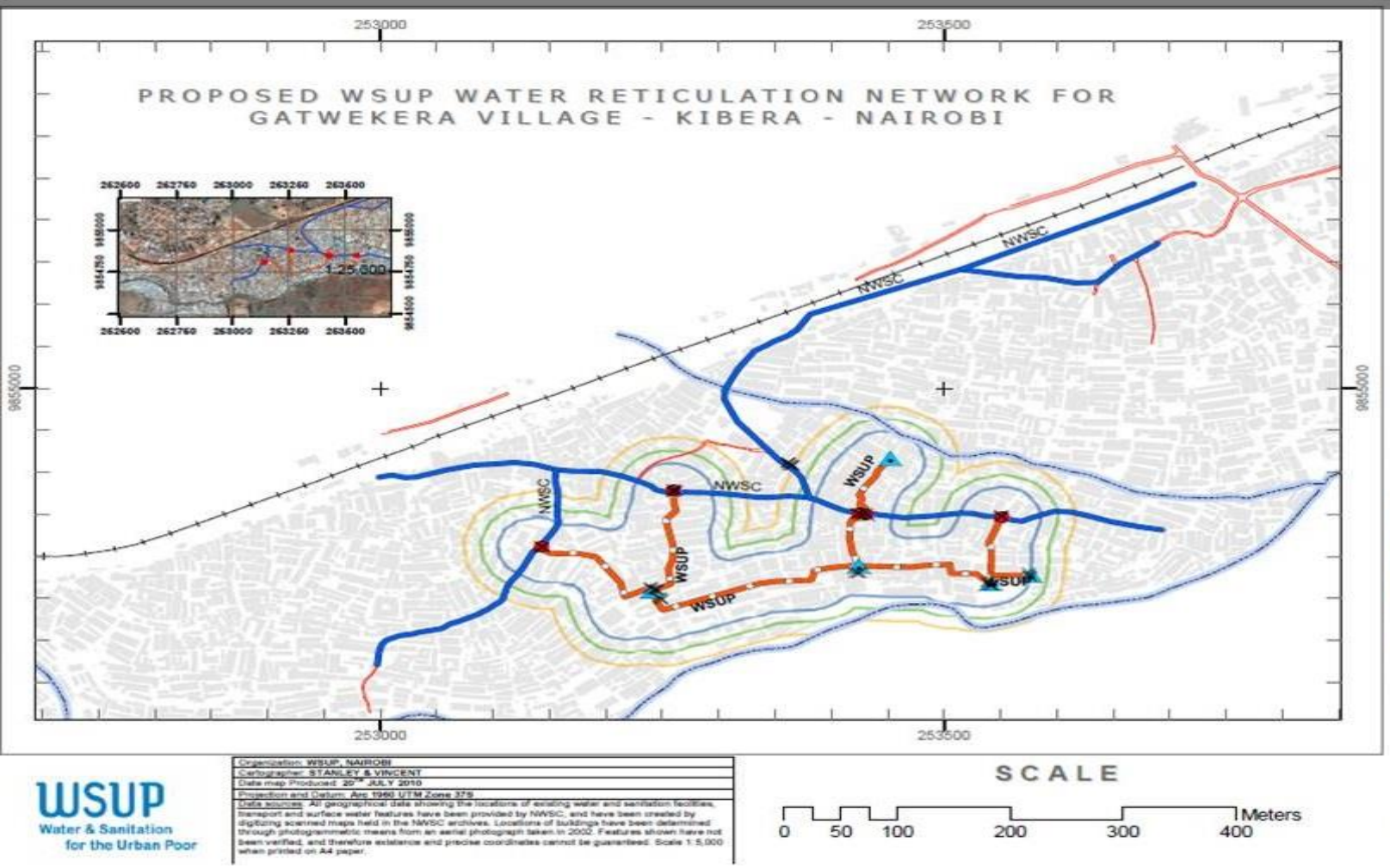
Capacity Building Results:

This map was submitted by one of the groups and is of similar standard reached by all the participants. The map demonstrates that the *TARGET CAPACITY* was reached. They learned how to navigate and collect data using a GPS; understand the limitations of the technology and the risks involved in 'blindly' using secondary sources of geospatial data. They made clear project maps with all the features a reader needs to independently orientate themselves and identify key features.



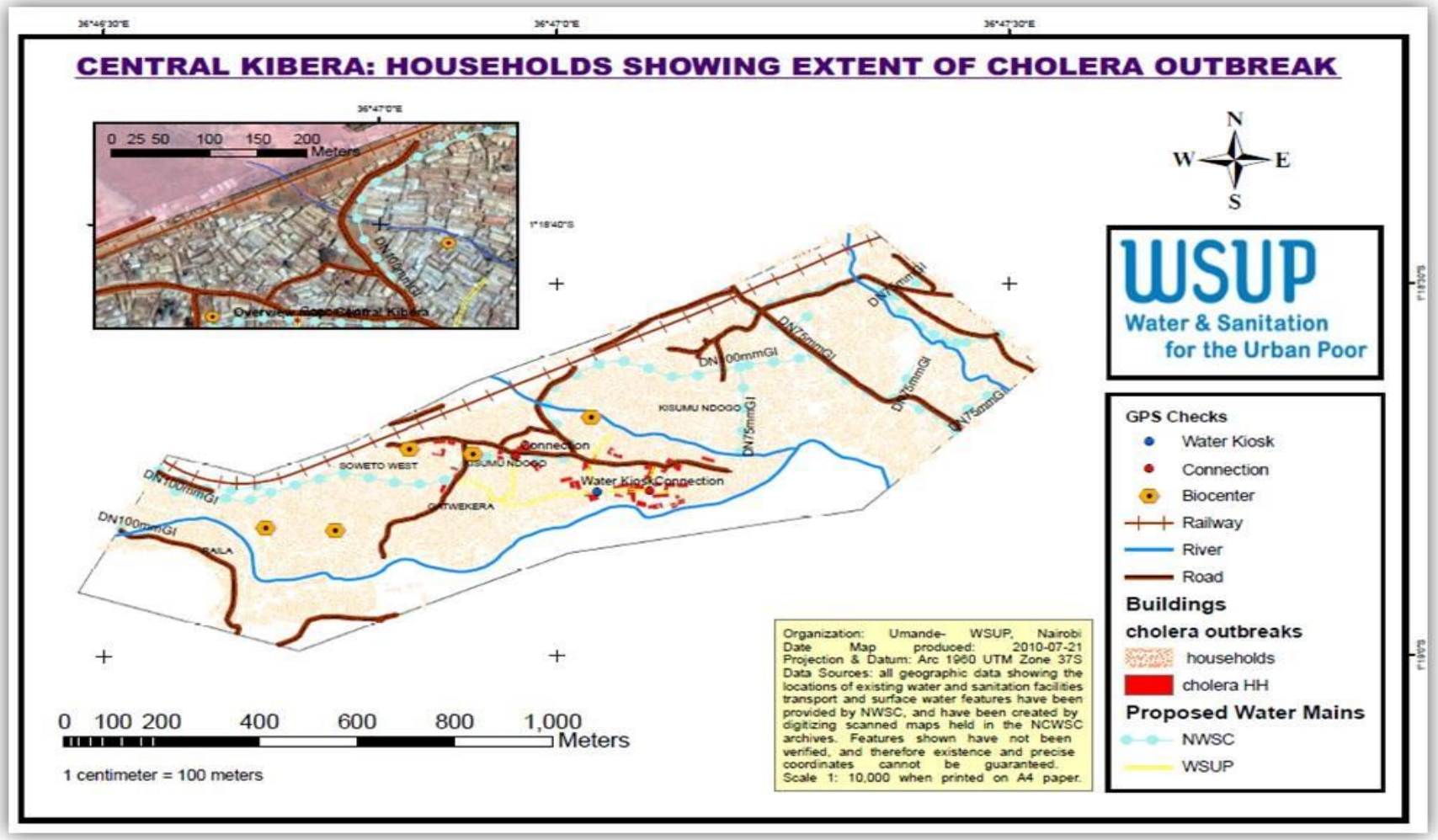
Some individuals struggled with particular areas namely, georeferencing of satellite images taken off Google Earth, and using the ArcGIS Digitising and Editing tools. However, though the interactive approach each group was able to collectively produce a map that met the key targets of the capacity building programme.

Exploring the Limitations of GPS & GPS:



Some groups explored additional applications of GIS & GPS. This map by some NCWSC staff shows the implications of having a 15m GPS reading error when calculating which households can be included in the proposed 50m *Social Connection Policy*. The scheme will only subsidise the connections for households that are within 50m (households outside this line would need to pay for pipe connections). Just as adding 2” onto the edge of a 7” pizza doubles the size of the pizza, the error of 15m on either side of a radial 50m threshold could have riotous implications!

Exploring other Applications of GPS & GPS:

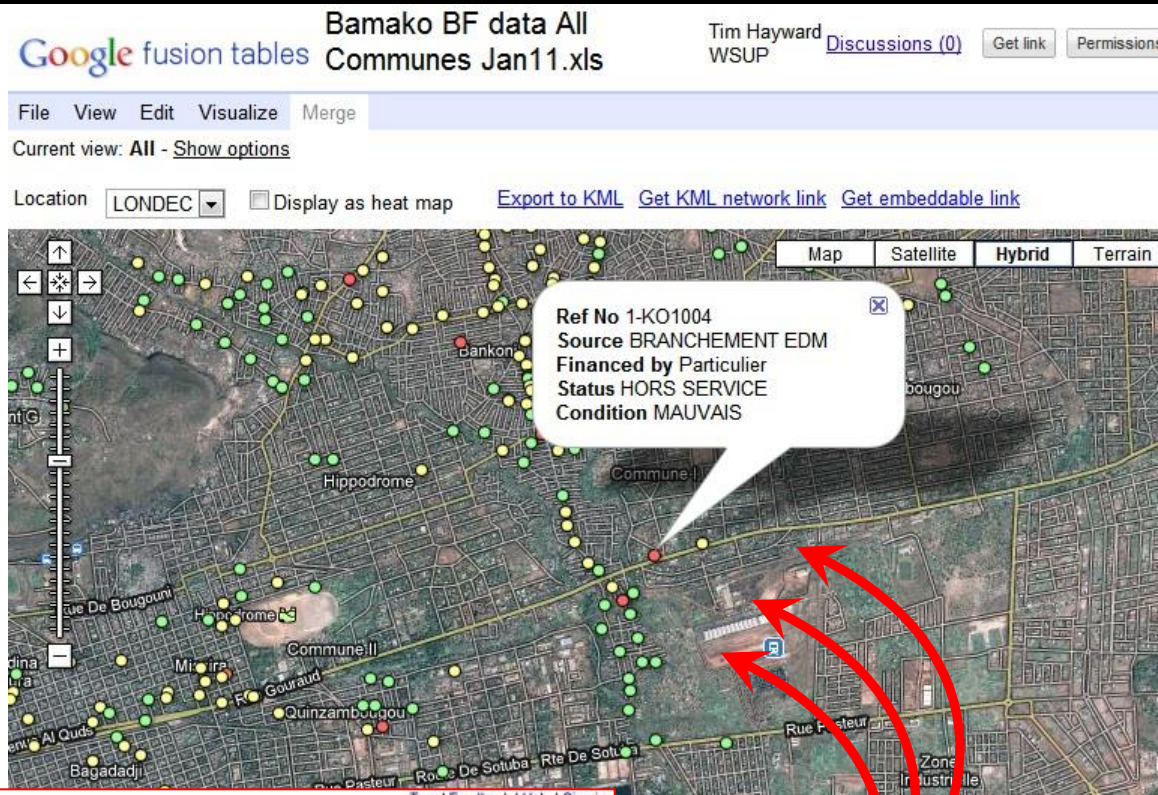


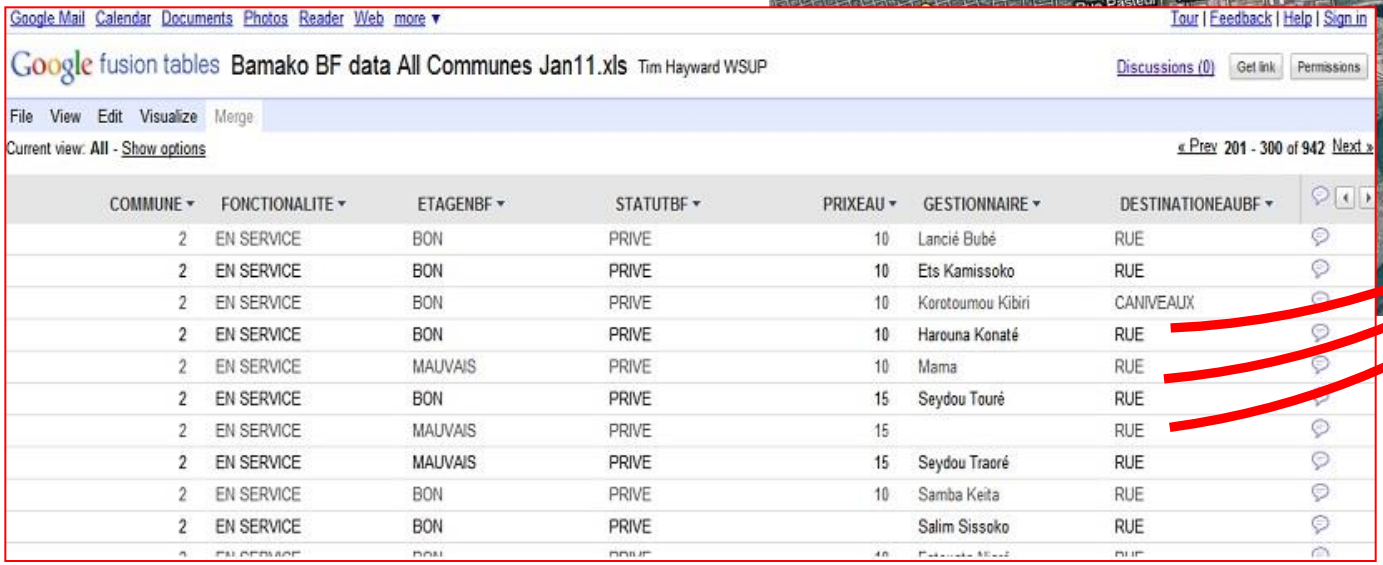
This map was created by the team from the Umande Trust after the course. It represents health data geospatially – allowing them to track health indicators in their project area.

This map is a hypothetical *Cholera Outbreak Map.* Cholera is still a significant risk to the urban poor living in Kibera, so the use of GIS and GPS to trace and arrest an outbreak must surely be seen as an essential application of this technology by WASH practitioners.

And elsewhere in Africa... Water Point Mapping in Bamako, Mali (WSUP)

Mapping of all public water points around the city of Bamako. A new free software from Google has been released called Fusion Tables. It can represent on Google Maps large amounts of data stored on an Excel spreadsheet. It's very simple to use, free, and allows the user to represent and very efficiently send large amounts project data via email by simply sending the link to fusion tables stored online.

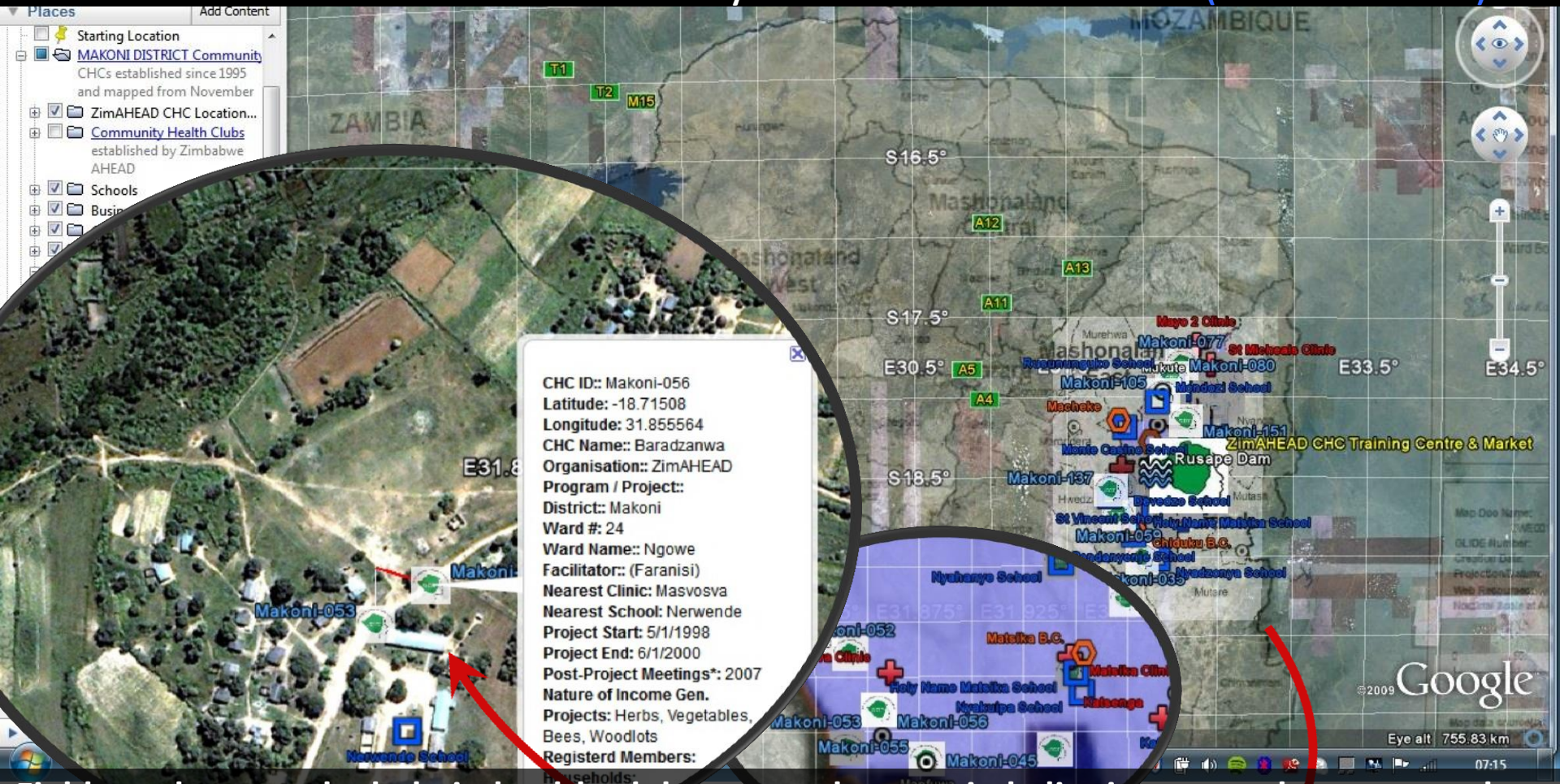




COMMUNE	FONCTIONALITE	ETAGENBF	STATUTBF	PRIXEAU	GESTIONNAIRE	DESTINATIONEAUBF
2	EN SERVICE	BON	PRIVE	10	Lancié Bubé	RUE
2	EN SERVICE	BON	PRIVE	10	Ets Kamissoko	RUE
2	EN SERVICE	BON	PRIVE	10	Korotoumou Kibiri	CANIVEAUX
2	EN SERVICE	BON	PRIVE	10	Harouna Konaté	RUE
2	EN SERVICE	MAUVAIS	PRIVE	10	Mama	RUE
2	EN SERVICE	BON	PRIVE	15	Seydou Touré	RUE
2	EN SERVICE	MAUVAIS	PRIVE	15		RUE
2	EN SERVICE	MAUVAIS	PRIVE	15	Seydou Traoré	RUE
2	EN SERVICE	BON	PRIVE	10	Samba Keita	RUE
2	EN SERVICE	BON	PRIVE		Salim Sissoko	RUE

And finally, in Zimbabwe...

Locations and social data from 164 Community Health Clubs in Makoni District (Zimbabwe AHEAD)



Field workers marked their health clubs on a photocopied district map; these were then located more precisely on Google Earth (not driving around the bush with GPS). The project map of the district was overlaid using a simple tool in Google Earth. Data from household surveys (indicators of water and sanitation uptake, membership numbers, project dates, Income Generating Projects etc) were entered on an Excel spreadsheet and transferred to Google Earth via a Google Fusion Table. A sophisticated map on a detailed satellite image – storing and representing vast amounts of data in a clear and user-friendly manner!


Speak your mind with maps!
N50°
N30°
Tropic of Cancer
N10°
Equator
E30°
E50°
E70°
E90°
W30°
W10° Meridian
S10°
Tropic of Capricorn
S30°
S50°