

**Report on flooding in the informal settlement, 'The Graveyard Pond',
Philippi, Cape Town, 2010 - 2011**



Picture 1: The path, filled with water, leads downwards into 'the pond'. Taken 30.03.2011, after half a day of rain

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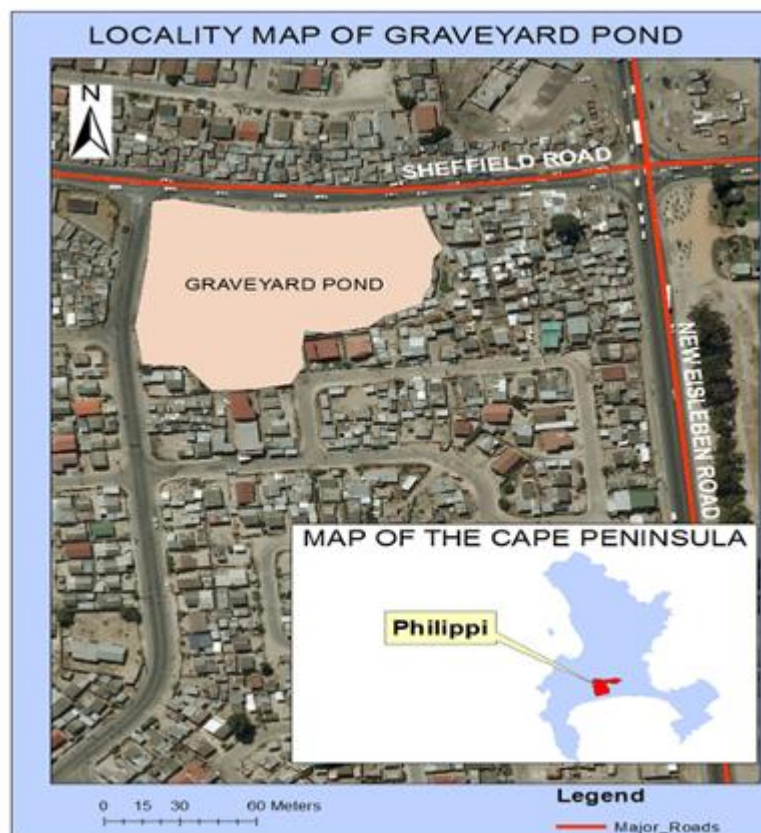
Acknowledgements: The research was carried out in collaboration with the community leaders of Graveyard Pond, who also did a great part of the data collection and monitoring. They have also read and validated this report.

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Introduction

The aim of this report is to provide data and a descriptive understanding of the flooding in one particular settlement that is particularly badly affected: Graveyard Pond in Philippi, Cape Town. By avoiding long theoretical discussions, this report provides empirical insight both for academics as well as for a wider audience.

Graveyard Pond (GP) is one of the approximately 350¹ informal settlements in Cape Town, as counted in 2008 (CoCTGIS Department count 2011).² In the industrial area of Philippi there are, according to the same 2008 count, approximately 55 informal settlements. Research on informal settlements in Cape Town has exposed that these settlements vary greatly, particularly in location, physical form, size, rural-urban linkage, internal poverty and vulnerability.³



Map by Kevin Musungu⁴

¹ The numbers change constantly, and increase every year, sometimes also due to splitting up of settlements.

² CoCT Strategic Development Information and GIS Department. 2011. *Informal Dwelling Count (Based on Aerial Photography) for Cape Town in informal settlements I (excluding Backyards) (1993 – 2008)* (unpublished report). A published count from 2007 can be accessed at:

<http://www.capetown.gov.za/en/stats/Documents/Informal%20Settlements%20Count.mht> (accessed 30.07.2011)

³ Smit, Warren. 2006. Understanding the complexities of informal settlements: Insights from Cape Town. In Huchzermeyer, M and A Karam (eds.) *Informal settlements: a perpetual challenge?* UCT Press: Cape Town.

⁴ Musungu, K. 2011. A Participatory GIS approach to Flood Risk Assessment of Informal Settlements: The Case of Cape Town. Unpublished MSc dissertation, University of Cape Town, Cape Town.

Methods

This report is based on data collected during the period 14.7.2010 and 31.08.2011. The data gathering process includes over 35 visits to the settlement during this period, carrying out participant observation, interviews with residents, a survey covering most of the settlement, workshops and engaging a 'flooding observer'.

In addition to the survey, most of the relevant information was gathered through visiting the informal settlement often (including when it was raining) and engaging in conversations with inhabitants. Particularly useful was the participation of the community leaders as 'research assistants' / 'flooding observers'. In June 2010 I engaged two flooding observers from another settlement and in 2011 (for 6 weeks in June to July) one of the community leaders in GP. The tasks of the flooding observer was to observe, note down comments and take pictures, and these comments and pictures form a large component of this report. Not only did this give interesting data and perspectives, but it also increased the confidence and interest of the assistant to work with the issue.

The report was also validated by the flooding observer and some of the community leaders.

Settlement Profile

The Graveyard Pond is located in a detention pond, as the middle lies lower than the edges of the settlement. This was confirmed by the GIS department of the City of Cape Town.⁵ There are few infrastructural developments; there are no internal roads, no proper drains, only a few water taps at the edges of the settlement and 15 communal toilets (most use the toilets of the neighbouring settlement according to the survey). There is an open sewer manhole in the middle, where people throw sewage water, and which has sometimes overflowed (see picture 2). There are severe flooding problems, not only in the winter but also in the summer whenever it rains, and this settlement seems to be worse affected than other settlements with flooding problems.



Picture 2: Open sewer manhole in the middle of the settlement, which overflowed during the winter of 2009
Picture 3: Storm water / sewage pipe with a grating. People throw waste and buckets with toilet sewage into here (since there are so few toilets in the area, many use buckets). I have not observed similar structures in any other settlements. 22.08.2011.

⁵Stated through communication with CoCT Strategic Development Information and GIS Department.

The Graveyard Pond is a fairly young informal settlement, as people started inhabiting the area about 10 years ago, but most people have lived here for less than 5 years. The year 2007 was the first year GP was acknowledged as a separate informal settlement, as in earlier counts it was considered part of the neighbouring settlement, The Graveyard. Since 2007, counts made by CoCT confirm that the number of shacks in GP has more than doubled. The data in Table 1 is based on own data gathered through interviews, observation, and a survey covering 279 households (approx. 81 % of the households), encompassing 795 residents:

Table 1

Number of shacks	344 shacks counted by CoCT in 2009, which has increased from 243 in 2008 and 154 in 2007. ⁶
Internal shack density	There are on average 3 (2.87) occupants in each shack, which is less than CoCT's general measure of occupancy rate per dwelling at 3.5. ⁷ 22.5 % of residents live alone, and the highest number of residents in one shack is 10.
Population	344 shacks with an average of 2.87 in each shack = approximately 987
Migration to settlement	The first people moved here 10 years ago. The average length of stay is 4.5 years. Most are born in Eastern Cape. 51.1% moved to GP from nearby areas (Philippi), 38.9 % from other areas in Cape Town, and 10 % from outside Cape Town (often EC).
Age groups	The average age of the head of household is 31 years. Of the 795 inhabitants included in the survey 22.52 % were 0-6 years, 16.85% 7-17 years, 50.44% 18-43 years, 9.06 % 35-64 years and 1.13% 65 + years old.
Languages	Majority Xhosa, 95 % . Other languages: Zulu 0.8%, Setswana 2.1%, Shona 0.4% and Sesotho 1.7%.
Employment	In 63.7 % of the households there is only one person employed. In 8.1% of the households there are two people employed, while in 28.2% there is no one who is employed. Of the employed, 35.2 % are employed full-time, 59.2 % part time, and 5.5% self-employed.
Welfare grants	51.4 % of households receive welfare grants. Of these grants, 90.8 % are child support grants.
Service delivery	15 toilets, but most use neighbouring settlement's toilets. No formal electricity, but connections to electricity from formal neighbours.
Disaster experience	41.4 % have experienced fire and 94.6 % flooding.

⁶ Data received, by request, from CoCT Strategic Development Information and GIS Department, which has counted informal dwellings by counting roofs, via aerial photographs by Corporate GIS of Strategic Development Information and GIS Department, captured from Feb 2002 and Nov 2009

⁷ op cit, CoCT

How and why people inhabited the area

As the survey conducted gave an inadequate understanding of why people moved to this place, conversations with several inhabitants gave a more complete picture:

The process of finding a shack in an informal settlement

The survey and interviews indicate that the higher areas close to the road were occupied first: *“There were no shacks there earlier. Children were playing there. People started building around the edges. Then more people moved into the pond.”* (Community leader 1, 6.4.2011). Now that the area is filled up, most of the newcomers buy shacks, because there is not much space to build any more. Prices range from R800 for a very small shack, to R3000 - R4000 for a larger one with several rooms. Many explain that finding a place to stay in any informal settlement is difficult:

“I had some friends here. I had been looking around for a while, did not find anything. I had been looking since the last year.

- *So how do you find out about vacancy?*

“You must walk around and ask people, and ask friends and colleagues. The lady who sold me this shack was working with me. She moved up the road, to the hair salon where your car is parked.”

(Inhabitant, 24.4.2011)

Flooding awareness when inhabiting the area

When buying shacks, the newcomers are not always informed about how bad the situation becomes in the winter. One family that just moved into a shack before the winter into the low lying area explains:

“Yes we bought the shack. The owner did not mention water then. As you can see there is a lot to do with the shack. There is water coming by the doorstep, will fix this

- *So what will you do?*

“Water is already here. I can see it will be bad. I will lift the floor up, but I need to buy material. It will be a two days job”.

(Inhabitant, 24.4.2011)

It seems that some were aware of the flooding when they moved to GP, but not of the extent of the flooding. One inhabitant explains he knew about the flooding when he moved here: *“Yes, there was already water, but not where I put the shack. But I did not know that the drain overflows...”*(Inhabitant, 28.9.2011)

Factors for choosing the area

Most residents do not view GP as a permanent place of residence; they hope to get relocated, In addition to the natural conditions discussed above, a number of other factors precipitated moving to the area:

Move from backyards:The main reason for moving to GP, after talking to several inhabitants, seems to be that they used to live in backyards, but could not afford the rent and wanted their own place: One of the community leaders explains:

“Yes[was living in backyard]. I was paying about R350. Then my cousin said it is better to stay here. When I came here there were not many places. Most people here come from backyards.”

Further, on questioning the difference of the conditions, he explains:

“The living conditions are better [in backyards], but here we do not pay.”

(Community leader, 28.08.2010)

Move from family: Secondly, as the statistics indicate there are many young adults living here. Many explained that they needed to move away from their family to become independent. A young woman, living alone explains the difference between living here and in Nyanga, where she moved from:

“There I was just a kid, here I am independent. And there we had own toilets. But now I live on my own”
(Inhabitant, 6.4.2011)

One of the community leaders, that seems to be familiar with this situation, comments:

“Because you are not free when you live with your parents. Maybe you want to meet with your boyfriend” ... [laughs]
(Community leader 1, 6.4.2011)

Another single woman, who works full time at a factory sorting plastic, has lived here for 3 years and explains:

“I had no other place to stay. I was staying with my family in Crossroads, they were staying in a backyard.”
(Inhabitant, 8.6.2011)

Job opportunities: Others moved here because it is closer to work than other informal settlements. For example, a woman living alone for three years in GP, working full time at the airport, said she moved here because it was close to work. Another example, a man who has lived in GP for 4 to 5 years explains:

“Before I lived in Guguletu. I came here to work, still looking for job. I go to the robots in Mitchells Plain to wait to get a job, people pick us up there. I am waiting for help to get relocated.”

- *How did you find this place?*

“I just walked around, other places were full. I looked in Langa, Khayelitsha, Kosovo. And then I came here.”

(Inhabitant, 24.4.2011)

Eviction: Lastly some people were evicted from the land nearby, which used to be an informal settlement but was turned into a RDP housing settlement, now called Better Life. They then wanted to find a new place close by and found Graveyard Pond. A woman that has lived in GP for 6 years explains:

“I moved from Phola Park, when Better Life was built, people moved from there. Some of my family got a house there.”

(Inhabitant, 24.4.2011)

It is also confirmed by the community leader that GP expanded when Better Life was built, as many of the informal settlers moved to the middle of Graveyard Pond (where the flooding is worse), which at that time was much less crowded.

Nature of the flooding

As the name indicates the middle area of this settlement which is lower sometimes turns into a pond when it rains. The water rises from below. Even in the summer, if it rains for only half a day, the water rises. The water enters some of the shacks, particularly the ones in the middle that are low-lying, and also floods the paths.



Picture 4: In the middle of GP, 14.07.2010

Furthermore, the problem is that the water stays for a long time because it does not sink. As a result it becomes still-standing grey-coloured water, which is mixed with garbage, which then becomes a health hazard. It eventually becomes green and smells bad, and some complain that they get skin rashes from this water.

The flooding happens mostly in the winter, and some winters are worse than others. Both 2010 and 2011 have not been as bad as 2009. Still, these notes from the inhabitant that reported on his observations in the settlement show the depth of the problem in 2011 (which was a year when it did not rain a lot):

“It’s been raining from 15 of June until 16 of June, day and night. In some of the shacks the situation is bad but not the whole area. At one shack they had to remove their beds and other stuff because of the water in the shack. In the morning they had to go to fetch the sand to put in the shack with help of their neighbours”

(Flooding observer, 16.6.2011)

Three days later:

“It’s been raining the whole night and it is still raining. There is flooding seriously, most of these shacks are in floods, it’s even difficult to walk because of floods. At one shack the whole shack is wet, they have been using buckets to get the water out of their shack. They keep on throwing the water out of the shack when the rain is better.”

(Flooding observer, 19.6.2011)

In addition to the rising water from below, the drains that are in the middle of the settlement have overflowed and seriously flooded the area. The last time this happened was in 2009:

“When it rains hard that drain overflows. Two winters ago the water came out of the drain and into my shack. One time I woke up my shoes were swimming there...”(Community leader 1, 15.9 2010)

Some areas are more severely flooded than others, especially in the middle, which is lower lying than the edges of the settlement close to the road. The almost constant presence of water beneath many of the shacks, particularly the ones in the middle where they have raised the floors, indicate that the area is a wetland. At one place, a woman moved her shack because of the health hazard. Where her shack used to be there is now a pond, as the picture below shows:



Picture 5: Pond where shack used to stand, 07.09.2010.

The constant water below some of the shacks in the middle of winter is making life uncomfortable:

“It is not nice. Especially in the winter when it is raining, the water comes inside....There is water even now, under the floor of the shack. You can see it if you lift up the carpet. And you hear frogs.”
(Inhabitant, 8.4.2011)

One of the community leaders, who also carried out the observation and reporting task, has pointed out that he thinks that this place is meant for water. He has seen a similar area nearby that is filled with water when it rains, which he describes as a detention pond (see picture 6).



Picture 6: Detention pond on the other side of the road. The community leader explains: *“This is another ground behind Lutheran church is full of water”* (Flooding observer, 16.6.2011.)

Effects of flooding and how it is experienced

The flooding affects the inhabitants in different ways, and some experience more flooding than others, depending on the location. However, as the paths between the shacks, where residents have to walk and where children play, become flooded, almost everyone is affected.

Health and damage to belongings: When entering shacks, the water does damage to belongings, particularly furniture and clothes, and the expenses of such damage can be difficult to cover for many inhabitants. However, the most common concern is health issues, because when it is cold and wet people become ill more easily. Statistics from the survey shows that 91.4% of participants answered that they or their family contract a cough or influenza after a flood, 28.3% a runny stomach, 15.1% rashes, and 11.8% TB. Children, particularly, become ill since they play in the standing water. Moreover, since it is expensive to heat shacks, many remain ill for longer periods and have difficulty resuming work.



Picture 7: *“There is water inside in the floor, and the child sits in the bed to keep from getting wet”* (Flooding observer 19.6.2011)

Anxiety: Prior to the arrival of winter, flooding becomes an anxiety for residents. Inhabitants follow the news and the weather forecast. Before the spring of 2011, some were worried because they heard the news about the flooding in other provinces of South Africa: *“We are also worried because we saw what happened with the water in other provinces...The flooding was bad there.”* (Community leader, 18.2.2011).

Even in the summer inhabitants worry:

“It is better now because it is not winter yet – but I am afraid. I hoped that when the winter arrives we would be in a better place...there is nothing you can do about this place, we rely on the City to help us. They must relocate us.”
(Inhabitant, 6.4.2011)

However, even though they hear about weather forecasts, they know that it is hard to predict how much it will rain:

“When you are sleeping and it is raining you have to wake up, because you are worried. I have to put sand in the floor and plastic on top. But the sand sinks. That’s what we do, since we come here, each and every year we put sand on the floors. One day of rain is enough; if it rains heavily one day then we are in trouble. This night at three I woke up...”
(Community leader, 24.5.2011)

Therefore, many express a feeling of helplessness regarding the flooding that they know will come:

“Only one day already you can see it’s like, it was raining for few days. We are worried, we don’t know what will happen if it rains for many day. It looks like this winter is going to give us tough time as compared to last year. The worse thing is that, there is not much we can do, because this area is meant for water but had no choice but come to stay because we had no other place to go.”
(Inhabitant, 16.6.2011)

What residents do to cope

Observations and several interviews confirm that most inhabitants make use of basic, practical improvements before and when it floods. These coping mechanisms include: putting plastic on roofs and floors, digging trenches in the paths leading the water away from the shacks, taking water out of the shacks, raising shacks, adding sand and rubble under the shacks and in the paths, building bridges, placing belongings at higher places and taking them to the neighbours.

Most residents do several of these things, and digging trenches seems to be particular prevalent. The flooding observer reports: “*Most people are digging trenches; some of them are putting sand in their shacks. Other people told me they had to wake up at night to remove the water in their shacks.*” (Flooding observer, 16.6.2011). These practical strategies help a little, but are not sufficient. For example, the trenches do not manage to take all of the water away, and sometimes it just results in other shacks being flooded.

Practical coping - improving collective areas



Pictures 8, 9:Water in paths and public areas: trenches. 6.9.2010.



Picture 10: The same angle as picture 8 above. " Here it has rained more, and the bricks that the inhabitants have placed are used to walk on." (Flooding observer, 14.07.2010)



Pictures 11&12: Bridges and stilts 25.04.2011, 07.09.2010.

Practical coping - water entering shacks:

Take out water, lift furniture and belongings: "Every winter there are problems with the water. At night I wake up and throw the water out." (Inhabitant, 25.4.2011)



Picture 13: “This woman, living in a shack in the middle of the settlement, used a bucket to take out water from the shack. The furniture in the background is raised on crates to avoid damage.” (Flooding observer, 19.6.2011).

Raise floors: Another example, as mentioned earlier, is that residents in the middle of GP raise the floors of the shacks, although this does also not help much because the water beneath the shack is so dirty that it can cause illnesses. Further, as stated by one of the inhabitants that raised their floor: “I raised the shack, put pallets under it. But when the drain overflows, it comes inside, then the raised shack does not help.”(Inhabitant, 6.4.2011). This can also be confirmed by the two pictures below, that shows the water under the floor in two different shacks.



Picture 14: Illustrates the floor in a shack where there is constant water under the floor of this shack, and the person living here just covers it with ceiling boards. She has been living here for 6 years. 14.07.2010



Picture: 15:The flooding observer explains it in this way:“*This is water underneath the floor. He stays in shack with water. He says sometimes it overflows.*” (Flooding observer, 16.6.2011)

Filling sand inside shacks: A single woman, who is sick, has her shack in the middle of the pond, and has stayed here for three to five years. She explains: “*Water comes inside. Sometimes I put sand inside, but it does not help. In 2009 when it was flooded here I moved back to my family, sometimes I had to stay there for 10 days.*”(Inhabitant 8.4.2011).



Picture 16: “*They are putting in sand with a wheelbarrow and they are leveling the sand*” (Flooding observer, 16.6.2011)

Relocating / Moving:

Particularly during the winter, inhabitants talk about moving their shacks. This is difficult, though; for instance, a woman who wanted to move her shack to a higher area of the settlement was unable to do so because she could not find any space there. Even though some move temporary to family or friends during the flooding, it seems that many remain in their shacks:

“There is nothing I can do until the water becomes better. I stay inside. I want to move, I am waiting for help, because I cannot afford another place.”
(Inhabitant, 8.6.2011)

The observer reported that people were not moving even though it had been raining for four days: *“We don’t know what will happen during the day because, it is still early. For now, we can still stay in our places and we are afraid clothes will be stolen...Most of them are just moving their stuff to better places or better shacks.”*(Flooding observer 19.6.2011)

However, it must be noted that, similarly to other informal settlements, on-migration to other areas is common,⁸ and some sell their shacks to move to better places.



Picture 17: Abandoned shack. The original inhabitants subsequently came back to live there again in August 2011. Picture taken 15.09.2010

Collective efforts and internal aid

For people co-habiting, the man often has to fix and upgrade the shack: *“It is better now, but on the back the water still comes. The husband filled the place on his own.”*(Inhabitant, 8.4.2011). However, other residents help the many who live alone (22.5 %) or are not able to cope with the flooding on their own. In particular, women living alone get help from neighbours and friends to improve their shacks to deter the water. In addition, neighbours dig

⁸ See e.g. Cross, C., Bekker, S and C. Clark. 1994. Migration into DFR informal settlements: An overview of trends. In Hindson, Doug and Jeff McCarthy (eds). *Here to Stay: Informal Settlements in Kwazulu-Natal*. Chapter 7. University of Natal: Indicator Press.

trenches in the paths together, e.g. borrow wheelbarrows to take sand from each other. Some residents, when badly affected, store their valuable possessions, like TV sets, clothes and blankets with neighbours or family while it is wet. A woman living in higher grounds and who not is that affected by the flooding states that she helps the ones living in lower grounds: *“Sometimes I help them, I keep their stuff and belongings while they are going away, because the water damages their stuff.”* (Inhabitant, 8.4.2011)

Involvement and aid from outside

Due to the limitations of the coping strategies, most inhabitants are hoping to be relocated:

“This has been happening for many years already, we were supposed to be moved away from this area a long time ago. We understand they say we came here on our own knowing this situation but we had no choice because we wanted a place to stay. We are South Africans, we deserve a better life. Our children are suffering, it’s wet here.”

(Flooding observer, 16.6.2011)

It is the internal community leaders that are expected to contact outside actors get help:

“Yes it is difficult to be a community leader. Because people do come to me. Especially people come here when there is flooding. The year before last year I tried to contact the councilor, but he did not come (2009).”

(Community leader 2, 6.4.2011)

Two years ago the inhabitants of GP got very little aid, and they blame this on the fact that GP used to be ‘under’ another settlement where the community leaders lived in an area on the other side of the road, which was less affected by flooding:

“Before we were under the neighbouring settlement. They contacted Disaster Risk Management, which came with blankets, but they [the neighbouring settlement] took everything and they did not give us anything.” (Community leader, 28.08.2010).

This was one of the reasons why the residents of GP split from the neighbouring community and formed their own committee, which is responsible for the area that becomes most flooded.

However, even this year (2011), there seem to have been some misplacement of aid:

“They visited Sagwityi Street and gave them blankets. But that surprised me that they gave blankets to the people in houses that are not flooded... The other community leader phoned the councilor of this ward and asked him what happened. We used to get sand, this year we had to go over there by the bridge.”

(Community leader 1, 27.7.2011)

It seems that local government was not aware of the magnitude of the problem before 2011. As the picture below shows, local government has become aware of the problem, and pamphlets were put up on the doors of many of the shacks in Graveyard Pond before the winter of 2011.



Picture 18, 19: Pamphlet on door from Disaster Risk Management. 30.03.2011.

Another thing that happened during the spring of 2011 was that the Disaster Risk Management department came to GP to teach the inhabitants about disaster awareness:

“The only people who came before the rain on the 14th of June are the people from Disaster Management. They had a workshop about disaster awareness, they taught us about floods, what we can do and what number we can call when there is disaster. They teach people about the awareness, that we must clean the trenches to make way for water, remove rubbish from the trenches, so they made a short play teaching people about floods.”

(Flooding observer, 16.7.2011)

However, the community leader comments that this workshop was not that helpful:

“There is not much I think about this situation, because all the advice we get from Disaster Management are not helping that much because we can’t control the situation. We dig trenches, we put sand and we raise structures, but that does not help much. We only need to be relocated. How I see this pond, it is meant for water.”

(Flooding observer, 16.7.2011)

The reasons for such information not being that helpful are that, in addition to that the strategies recommended by Disaster Management already are familiar to most inhabitants, the natural conditions at this location are particularly bad. The inhabitants in the middle of the settlement have located in a very low lying area, which seems to be natural wetland. The inhabitants are aware of this problem, and do as best as they can to cope with it. This awareness might be more significant than the knowledge of the Disaster Management, which probably is taking a general and standardized approach: *“Yes, they [Disaster Risk Management] had a workshop in the street behind the shop. It was interesting because they had a play, it was funny. But I told them that our settlement is a different story, because the water comes from underneath.”*(Community leader 22.7.2011).

Summary

The Graveyard Pond is a relatively recent informal settlement that seems to have been formed as a result of gradual and unplanned occupation of land. The settlement is located in an area that makes it particularly prone to flooding. However, people have settled there as a last resort, as they could not find other locations. Generally, the main reasons for residents moving there are that it is close to job opportunities, that they were evicted from a the neighboring settlement (Phola Park) due to upgrading (into the RDP settlement Better Life), that they wanted to move away from family to acquire their own space, and that they could not afford rent in backyards. These reasons, in addition to the fact that it is very difficult to find spaces in better-located informal settlements, seem to have outweighed the flooding factor. However, residents do not want to stay there but dream of being relocated.

While hoping to move, they apply basic coping measures to deal with the flooding risk. These coping mechanisms are however insufficient, because, due to the terrain, the water fails to drain for a long time, often settling beneath the floors of the shacks, and the health hazard this can cause is likely to be significant. In its present state, this area, particularly the lowest lying part, appears to be unsuitable for healthy living.

Further directions

As this area is badly affected by flooding and the coping mechanisms are not sufficient, this suggests that more collaboration with other scales is needed. However, collaboration and interaction is not a simple issue, and development projects in such areas have often failed due to social and political situations.⁹ Therefore, better understanding is needed on how informal settlements are formed, organized internally, in addition to barriers to interaction across scales. These issues will be followed up by the FliCCR project in forthcoming research.

Pictures:

Own pictures: 1, 2, 3, 5, 8, 9, 11, 12, 17, 18, 19.

Taken by flooding observer 2010: 4, 7, 10, 14

Taken by flooding observer 2011: 6, 7, 13, 15, 16

⁹ See eg: Armitage, N, Beauclair, R, Ashipala, N, Spiegel S. 2010. *Draining the shantytowns; Lessons from Kosovo informal settlement, Cape Town, South Africa*. Paper presentat at NOVATECH 2010: 7th International Conference on Sustainable strategies and techniques in urban water management. <http://documents.irevues.inist.fr/bitstream/handle/2042/35630/12202-282ARM.pdf?sequence=1> (Accessed 20.06.2011).