

Visits to Communities in the Municipality of León, affected by flooding in October 2007



Background

Intense rainfall in October resulting in significant flooding in many parts of western Nicaragua. In the month of October, this region received 548.3 mm of rainfall which is 80% higher than the long-term average for the month of October. In the second 'decena' of the month the rainfall was 270% higher than the long-term average for that period (INETER). Many parts of the Department of León suffered severe flooding resulting in significant loss of crops and damage to houses and other infrastructure. A subsequent outbreak of *Leptospirosis* led to 9 deaths and hundreds of others hospitalized in León and Chinandega. In the aftermath of the floods, concern was expressed by MINSA and the Alcaldía de León that wells in the Municipality of León had been contaminated by floodwaters, increasing the risk of epidemics of water-borne diseases. Community members had passed reports to MINSA and the Alcaldía suggesting that wells contaminated by flooding were responsible for cases of diarrhoea and that the water had become 'pesada' (meaning that it had a mineralised or saline taste and did not easily allow soap to form a lather). Nuevas Esperanzas was asked by the Department of Risk management of the Alcaldía de León to investigate the possible contamination of wells in the municipality and to assist with any remediation necessary.

Site visits

Visits were made to the communities of Sagrado Corazon de Jesús (El Malinche and Milagro de Dios), La Leona, Los Angeles, Abangasca Sur and Goyena Sur on 20th and 23rd of November, accompanied by representatives of MINSA and the Alcaldía of León. Samples were taken from various wells and analysed for turbidity, Total Dissolved Solids (TDS), pH, chlorine residual (in the case of already chlorinated sources) and faecal coliforms (in the case of non-chlorinated sources). Faecal coliforms (*E. coli*) were sampled using the Oxfam DelAgua kit, based on the membrane filtration method, incubating samples at 44° for 18 hours. A visual inspection was made of the different wells and owners were interviewed about the impact of the floods on their wells.

Comarca Sagrado Corazón de Jesús (El Malinche)

A well was sampled in the concentrated community of El Malinche, a housing project built by Project Hope. The well (NAD27 grid co-ordinates 0520650, 1362850) was shared by four families. The well was fitted with a rope pump mounted on a wooden cover which did not cover the well properly. The water level was at 1.5 m below ground level and the well was neither lined nor protected with a drainage apron. Latrines in this community are generally raised and sealed. The users of the well described the water as 'pesada' but did not seem particularly unhappy about their water. The well did not flood although the water table was very close to the surface. The results obtained from this well were as follows:

Turbidity:	<5 NTU
pH:	7.0
TDS:	440 mg/l
<i>E.coli</i> :	60/100 ml

Given the relatively poor protection of this well, the faecal coliform count is not as high as might have been expected. The low turbidity and neutral pH permitted chlorination and the

well was disinfected after the sample had been taken. Chlorine tablets (NaDCC, 100 mg available chlorine) were left with the owner for future chlorination after an appropriate dose had been established. The TDS may perhaps be higher than the community are used to, but are well within acceptable limits. Given the communal nature of this well, the concentrated nature of the housing development, the poor protection of the well and the high water table, this community may be considered vulnerable to water-borne disease and ongoing chlorination of the water source, at least during the wet season, is recommended. There was no evidence that this well was adversely affected by flooding.

Comarca Sagrado Corazón de Jesús (Milagro de Dios)

The other well sampled was in the concentrated community of Milagro de Dios, again a Project Hope housing project. This communal well (0521470, 1362130) was a drilled borehole fitted with a rope pump. Again there was no drainage apron and the borehole casing had been cut off very close to ground level, affording very little protection in case of flooding. The community was unsure as to whether the well had actually flooded. The results obtained from this well were as follows:

Turbidity:	<5 NTU
pH:	7.0
TDS:	290 mg/l
<i>E.coli</i> :	1/100 ml

As this was a drilled borehole with casing to prevent water entering through superficial deposits, low faecal coliform counts would be expected. However, the poor protection of the head of this well left the borehole open to contamination. The low faecal coliform count suggested, however, that this communal source should not be a cause for concern. It is difficult to understand why the community considered this water 'pesada' with TDS of only 290 mg/l. The disadvantage of this borehole equipped with a rope pump is that chlorination of the source itself is not really possible. As a communal well in an area with a high water table, it is recommended that improvements are made to the protection, although there was no evidence that this well was adversely affected by flooding.

La Leona

The well at La Leona sampled was a private well in this dispersed rural community. The well (0517600, 1364710) was open with no cover but had a well-built surround and was partially lined. Water was drawn by a bucket and rope. It appeared to be well cared for and had been chlorinated approximately 15 days previously. The results obtained from this well were as follows:

Turbidity:	<5 NTU
pH:	7.0
TDS:	310 mg/l
Free chlorine:	trace (<1 mg/l)

In view of the presence of a chlorine residual, no sample was taken for bacteriological analysis. There is no evidence that this well was adversely affected by flooding.

Los Angeles

The well sampled in this dispersed community was in a farmyard next to a trough where cattle were drinking. The well (0514460, 1368100) had a concrete surround but was open and unprotected with a bucket and rope to draw water. The users said that this water was very 'pesada' and that they did not use it to drink, bringing water for drinking from León instead. The Alcaldía had been providing tankered water to this community following the floods,

although the wells here were not actually flooded. The results obtained from this well were as follows:

Turbidity: <5 NTU
pH: 7.0
TDS: 1,390 mg/l
E.coli: 35/100 ml

The faecal coliform count in this well was not particularly high, especially when its setting and lack of protection are taken into account. The major cause for concern, however, was the high TDS, which exceed permissible limits. It is perfectly understandable that this community regarded the water as 'pesada'. It is not clear whether this phenomenon is related to high water table or whether the water in this well is naturally saline. A neighbouring well was sampled and also showed similarly high TDS. A few km from this community, however, another well (0514190, 1369880) was sampled and found to contain TDS of only 240 mg/l. It is recommended that this issue is followed up as the water table drops over the course of the dry season to determine whether this is a perennial problem. If so, it may be that local hydrogeological conditions are giving rise to high salinity. The well was not chlorinated as it was not used for drinking.

Abangasca Sur

As one of the communities most adversely affected by flooding in the municipality, a number of samples were taken here. There has clearly been a number of previous interventions from NGOs in this area as there are numerous boreholes equipped with simple piston pumps (installed by a German NGO according to residents) and others with India Mk 2 handpumps (installed by Living Waters). The visit to this community was accompanied by students from Yale University who were undertaking their own sampling work. Turbidity values were measured using their (more sensitive) instrumentation.

A private well (0514170, 1369880) in a farmyard was sampled. This had a simple surround and no cover and the water table was less than 1 m below ground level. The users complained that the water was 'pesada' and said that the floodwater rose to half way up the well surround (but did not overtop the surround). The results obtained from this well were as follows:

Turbidity: 0.1 NTU
pH: 6.8
TDS: 420 mg/l
E.coli: 70/100 ml

Given the relatively poor protection of this well, the faecal coliform count is as would be expected. The low turbidity and neutral pH permitted chlorination and the well was disinfected after the sample had been taken. Chlorine tablets were left with the owner for future chlorination after an appropriate dose had been established. The TDS may perhaps be higher than the community are used to, but are well within acceptable limits.

Another well (0507226, 1377032) was sampled which had no protection at all. The well was unlined and had no surround or cover. Plants were growing inside the edge of the well. This well was flooded from above. The owner said that he did not use this well for drinking but instead carried water from a drilled borehole equipped with India Mk2 handpump. The results obtained from this well were as follows:

Turbidity: 1.7 NTU
TDS: 520 mg/l
E.coli: 96/100 ml

Considering that this well is completely unprotected and was actually flooded, the faecal coliform count was surprisingly moderate. The well was not chlorinated as it was not used for drinking.

A borehole with an India Mk2 handpump (installed by Living Waters) was sampled (0507346, 1376358). This well is very well protected (although it surprisingly did not have a drainage apron). The results obtained from this well were as follows:

TDS:	190 mg/l
<i>E.coli</i> :	0/100 ml

Not surprisingly, this well protected source was the only one sampled which showed an absence of faecal coliforms. It also had the lowest TDS which is interesting since the water is drawn from a deeper part of the aquifer.

No samples were taken for bacteriological analysis from the boreholes equipped with piston pumps although it was observed that they generally produced water that was turbid (>20 NTU) and unfit for chlorination. This is because of the poor borehole and handpump design and is unrelated to the flooding. Although some wells in Abangasca Sur were adversely affected by flooding it appears that there is sufficient safe water available from the protected boreholes.

Goyena Sur

The well sampled at Goyena Sur was a private well shared between two families in a dispersed community hit badly by the flooding. The well was protected and lined with steel drums, although this would have provided little protection from surface flooding. The owners were unsure whether or not floodwaters entered the well from above, but complained of the water being 'pesada'. There was no cover and water was drawn with a bucket. The results obtained from this well were as follows:

Turbidity:	0.8 NTU
TDS:	800 mg/l
<i>E.coli</i> :	77/100 ml

Considering that this well is poorly protected, the faecal coliform count was not as high as might be expected. The TDS were high, though still within acceptable limits for drinking water supplies. The low turbidity permitted chlorination and the well was disinfected after the sample had been taken. Chlorine tablets were left with the owner for future chlorination after an appropriate dose had been established.

Conclusions

The majority of the wells visited during these site visits were not adversely affected by the floods of October 2007. Even in the case of a well where floodwaters entered directly, the turbidity was low and there is not considered to be any reason to pump out any of the wells visited. The vulnerability of the sources due to the high water table was not directly attributable to the flooding as these levels were typical for most of the wet season in each of the communities. The bacteriological analysis closely reflected the level of protection of each well, although with all samples containing fewer than 100 *E.coli*/100 ml, these wells should actually be considered better than many in this part of Nicaragua. In concentrated communities with open or poorly protected wells, it is recommended that chlorination is undertaken. In dispersed communities, the individual owners would need to take responsibility for this themselves. On the basis of these site visits, emergency well disinfection and remediation work following the floods is not considered necessary as wells were found to be in a typical state for the wet season and well protection and disinfection needs to be managed on a long-term basis, not as a short-term measure.

An important issue that should be followed up in the medium-term, however, is the high TDS encountered at Los Angeles. Further monitoring will be undertaken and if, necessary, a proposal may be drawn up for the development of alternative water sources (e.g. rainwater harvesting).

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