Riser pipes mismatched and not inserted properly by contractor – Mchinji District
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<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AfDB</td>
<td>African Development Bank</td>
</tr>
<tr>
<td>AM</td>
<td>Area Mechanic</td>
</tr>
<tr>
<td>ADC</td>
<td>Area Development Committee</td>
</tr>
<tr>
<td>AWP</td>
<td>Annual Work Plan (District Assembly)</td>
</tr>
<tr>
<td>BMO</td>
<td>Borehole Maintenance Officer</td>
</tr>
<tr>
<td>BoQ</td>
<td>Bill of Quantities</td>
</tr>
<tr>
<td>CBM</td>
<td>Community Based Management</td>
</tr>
<tr>
<td>CBCCC</td>
<td>Community Based Child Care Center</td>
</tr>
<tr>
<td>CDA</td>
<td>Community Development Assistant</td>
</tr>
<tr>
<td>CPAR</td>
<td>Canadian Physicians for Aid Relief</td>
</tr>
<tr>
<td>DCDO</td>
<td>District Community Development Officer</td>
</tr>
<tr>
<td>DCT</td>
<td>District Coordination Team</td>
</tr>
<tr>
<td>DEHO</td>
<td>District Environmental Health Officer</td>
</tr>
<tr>
<td>DEC</td>
<td>District Executive Committee</td>
</tr>
<tr>
<td>DEM</td>
<td>District Education Manager</td>
</tr>
<tr>
<td>DEO</td>
<td>District Environmental Officer</td>
</tr>
<tr>
<td>DFO</td>
<td>District Forestry Officer</td>
</tr>
<tr>
<td>DIO</td>
<td>District Information Officer</td>
</tr>
<tr>
<td>DoF</td>
<td>Director of Finance</td>
</tr>
<tr>
<td>DPDO</td>
<td>District Planning and Development Officer</td>
</tr>
<tr>
<td>DPW</td>
<td>District Public Works Officer</td>
</tr>
<tr>
<td>DRA</td>
<td>Demand Response Approach</td>
</tr>
<tr>
<td>DSIP</td>
<td>District Strategy and Investment Plan</td>
</tr>
<tr>
<td>DSWO</td>
<td>District Social Welfare Officer</td>
</tr>
<tr>
<td>DWC</td>
<td>District WASH Coordinator</td>
</tr>
<tr>
<td>DWL</td>
<td>Dynamic Water Level (within a borehole when yield tested)</td>
</tr>
<tr>
<td>DWO</td>
<td>District Water Officer</td>
</tr>
<tr>
<td>EC</td>
<td>Electrical Conductivity (of water)</td>
</tr>
<tr>
<td>EM</td>
<td>Electro-Magnetic (of geophysical survey)</td>
</tr>
<tr>
<td>ESP</td>
<td>Electric Submersible Pump</td>
</tr>
<tr>
<td>FBO</td>
<td>Faith Based Organisation</td>
</tr>
<tr>
<td>GVH</td>
<td>Group Village Headman</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>HSA</td>
<td>Health Surveillance Assistant</td>
</tr>
<tr>
<td>IPC</td>
<td>Internal Procurement Committee</td>
</tr>
<tr>
<td>M&amp;EO</td>
<td>Monitoring and Evaluation Officer</td>
</tr>
<tr>
<td>MBS</td>
<td>Malawi Bureau of Standards</td>
</tr>
<tr>
<td>MP</td>
<td>Member of Parliament</td>
</tr>
<tr>
<td>MoE</td>
<td>Ministry of Education</td>
</tr>
<tr>
<td>MoH</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>MoAIWD</td>
<td>Ministry of Agriculture, Irrigation and Water Development</td>
</tr>
<tr>
<td>NCB</td>
<td>National Competitive Bidding (of tendering procedures)</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organisation</td>
</tr>
<tr>
<td>NWDP</td>
<td>National Water Development Programme</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>Operation and Maintenance</td>
</tr>
<tr>
<td>ODPP</td>
<td>Office of the Director of Public Procurement</td>
</tr>
<tr>
<td>pH</td>
<td>Measure of acidity / alkalinity (of water)</td>
</tr>
<tr>
<td>RFP</td>
<td>Request For Proposal</td>
</tr>
<tr>
<td>RHC</td>
<td>Rural Health Center</td>
</tr>
</tbody>
</table>
RWS  Rural Water Supply
SWL  Static Water Level (within a borehole)
T.A  Traditional Authority
ToR  Terms of Reference
UG  User Group (of a water point)
UNICEF  United Nations International Child Education Fund
VAP  Village Action Plan
VES  Vertical Electrical Sounding (of geophysical survey)
VLOM  Village Level Operation and Maintenance (hand pump repairs)
VDC  Village Development Committee
VHC  Village Health Committee
WASH  Water, Sanitation, Health
WPC  Water Point Committee (village WASH Committee or V-WASHE)
WMA  Water Monitoring Assistant

CONTRACTOR ABBREVIATION (found on Charts)

CADCO  Central African Drilling Company (Blantyre)
CGEC  China Gansu Engineering Corporation (Lilongwe)
CDC  Commercial Drilling Company (Lilongwe)
Chits  Chitsime Drilling Company (Lilongwe)
HWW  Hydro Water Well (Lilongwe)
KD  Keiretsu Drilling (Lilongwe)
MDC  Master Drilling Company (Blantyre)
Select  Select Drilling (Lilongwe – same office as Chitsime)
Sfro  Saifro (Lilongwe – part of BIAC India)
TD  Tropical Drilling (Lilongwe)
WBC  Water Boring Contractors (Lilongwe)
WDC  Water Drilling Contractors (Blantyre)
UBD  Universal Borehole Drillers (Blantyre – same offices as CADCO)

HAND PUMP MANUFACTURE ABBREVIATION (found on Charts)

AJAY  AJAY Industrial Corporation (India)
AOV  AOV International (India)
APEX  APEX International (India)
BIAC  Balaji Industrial and Agricultural Castings (India)
INTEC  Intec Tools (India)
MAYA  MAYA Engineering Works (India)
PP  Polyplast Ltd (Blantyre)
SPAN  Span Pumps Private Ltd (India)
EXECUTIVE SUMMARY

In the period Aug – Nov 2011 RWS Ltd carried out a quality assurance review of UNICEF drilling programmes including a 20% sample of 500 constructed boreholes, a broad review of tendering procedures, stakeholder participation (particularly within district) and construction and WPC training procedures (at live sites). 102 existing borehole structures (selected at random) were visited in the six districts selected (Mzimba, Nkhatabay, Lilongwe, Mchinji, Blantyre and Mangochi).

Live construction or training sites could not be investigated in depth under this review because the Contractors and Districts were all but immobile due to national fuel shortages. Thus this review measures, assesses and analyses completed products not actual construction or training techniques.

Main Deductions

Various indicators have been generated as percentages on a randomly selected sample of 102 boreholes and hand pumps completed over the last 5-years. Although the sample size could be bigger the percentages are regarded as statistically robust and representative of the 2,000+ water points that have been funded by UNICEF.

On hand pump functionality (sample size 102):-

- 93% are functioning and used for all domestic water
- 3% are permanently out-of-action (beyond repair)
- 4% are working but not used for drinking water (poor quality)

The 3% out-of-action are all due to excessive siltation and blocking of the pump cylinder. This is underpinned by a) difficult local hydrogeology (saturated and highly collapsing ground) and b) very narrow drilling diameter coupled with the wrong drilling technique. Data suggests that a further 5% of the functional boreholes also have a latent siltation problem that may cause the borehole / hand pump to fail prematurely in the future.

On community satisfaction (sample size 100):-

- 76% are satisfied with yield and quality
- 12% are not satisfied with yield (these are all low to very low yield boreholes)
- 7% do not use for drinking water (salt and/or iron above WHO guidelines)
- 5% more are not satisfied with quality (salt and/or iron nearing WHO guidelines)

The low yield occurrence is frequently related to shallow drilling depth. Indeed 78% of the low yield boreholes are less than 45m deep and 50% are less than 40m deep. Shallow depth is often caused by the contractors’ inability (or reluctance) to go deeper and fully penetrate the aquifer. This in turn can be related to very narrow drilling diameter coupled with poor drilling technique and/or poor equipment in very loose and saturated formations.

Not only depth but poor site selection (geophysics) contributes to the occurrence of low yield boreholes. Of the 2,000 UNICEF-funded boreholes it is calculated that an additional 27.5% (or 550) have been abandoned dry or with very low yield. Two contributing factors are indicated, a) contractor reluctance to up-grade geophysical survey and b) tendency of WPCs to provide preferred spots as defined “points” rather than general “areas”. Low-yield outcome is accentuated in areas of difficult hydrogeology.
These measurable factors are only the “tip of the iceberg”. There are additional potential problems hidden down sampled boreholes that are currently functional and used. There are also potential user O&M irregularities to consider. Thus, as the years pass it will be a percentage of these same boreholes and hand pumps that tend to breakdown more frequently with some being abandoned completely – because the users are either unable or unmotivated to repair. This type of problem could be related to one or more of the following in approximate order of severity (not an exhaustive list). The percentages are estimated based on the field observations during survey:-

- Premature wear caused by abnormal use (>100 households), up to 15%
- Pump neglect by non-motivated WPCs, up to 10%
- Excessive siltation up around the pump barrel (exacerbated in shallow boreholes), 2-5%
- Poorly quality hook and eyes on the rods - snapping off and failing to be fished, up to 3%
- Rocking pedestals causing rapid wear of down-hole components, up to 2%
- Bent bores and off-vertical pedestals causing premature rod/riser wear and failure, up to 2%
- Incomplete fitting of riser pipes / sockets or cut risers with waisted double sockets, up to 2%
- AMs or bush-mechanics who join dislocated risers by heating, burning and warping ends, up to 2%
- Damaged cylinder components caused by poor timing and inability to “fish” up to 1%
- Non-availability of spares to match four different cylinder arrangements (indeterminate %)
- Dropping of pumps parts by careless WPCs and/or AMs (indeterminate %)
- Theft of pumps and rods / riser (indeterminate %)
- etc.

The current review is carried out on water points that average 2 years and do not exceed 5-years in age. All of the above indicate that hand pump functionality is heading for the 80% or even 70% mark by the end of 5-10 years of constant usage by ever-expanding user communities.

All the above issues can be reduced with attention to several crucial areas

1. Ensuring that professional, well-equipped contractors are appointed and that the right techniques are employed throughout all 6 construction steps (siting through to installation)

2. The current subtly differing contract styles are edited and aligned. The current MoAIWD contract has general omissions and lack of technical specification detail – which, in effect, allow the contractors to practice poor techniques

3. Ensuring that the pool of district supervisors (WMAs) is increased and better trained. The current poor level of supervisor knowledge and technique allows the contractors to practice poorly and this leads to poor quality products. Poor supervisor reporting skills and poor ethics are also instrumental and both need attention.

There are many other issues that do not really pose a threat to hand pump sustainability but are nevertheless important. These include:-

- Avoidance of pollution sources and other hazards during siting
- Quality, dimension and durability of civil works
- Waste water management by users – soak-away, garden, cleaning etc.
- Poor quality of civil works materials supplied by communities
- etc.
In final summary all the above highlighted points are very real and will not reduce unless the following are addressed:-

- Contracts are uniform and the technical specifications cover all construction topics and steps
- Contractors adhere to the technical specifications without deviation or omission
- Contractors are supervised properly by supervisors during all 6 construction steps. This is essential.
- The supervisors are well trained, proactive, honest and motivated
- The supervisory process is well documented and stored (by the districts)
- The DWOs, WPCs and AMs are trained and alert to both good and bad hand pump O&M practice

The Stakeholder Review Workshop was held on 30th November 2011. wherein the participants were informed of the findings of the quality assurance survey (Sections 5, 6 and 7) and then agreed on the following changes, including a schedule of implementation (Section 10):-

- Contract standardisation such that loop holes are closed and specifications are full and clear
- Prequalification of contractors such that districts evaluated pre-qualified and quality tenders
- Professional siting applied in the “difficult” areas – encouraged by “flat rate” item in contract
- Decentralisation of procurement and management of contracts
- Supervisor training including all construction steps, contract specification and reporting
- Supervisor numbers to be increased
- Review of community based management manual (WPC roles and responsibilities in particular)
- Revision of community based contributions (from “in-kind” to cash contribution to the O&M fund)
- Formation of borehole stakeholder association to promote stakeholder dialogue

Other important issues were not attended in the time available at the workshop – and still need attention. These are introduced at the end of covered in Sections 5, 6 and 7 and also in Annex 1
1 INTRODUCTION

UNICEF in partnership with the Government of Malawi is implementing Water, Sanitation and Hygiene (WASH) activities with comprehensive WASH packages in 14 focus districts across the country. In line with government policy UNICEF implements their programmes through decentralized structures and the district councils with guidance coming from the Ministry of Irrigation and Water Development (MoIWD). To date more than 2,000 new rural water points have been drilled under UNICEF funding using the following contractual mechanisms:-

• UNICEF directly contracts and administers the drilling contract
• MoIWD directly contracts and administers the drilling contract
• District Council directly contracts and administers the drilling contract
• District council directly contracts but leave payment to UNICEF after invoice approval

In all instances it is the districts that manage the implementation steps:-

• Select the communities to benefit from borehole and hand pump
• Prepare the communities for siting and drilling by training and set up of Water Point Committees
• Supervise of the sequential construction steps to ensure quality and long-lasting products
• Check and endorse the contractors invoices for payment

This review was commissioned by UNICEF to snapshot the current effectiveness of procurement and field processes related to the drilling, the role of the district councils in these implementation processes and indeed the quality of the finished water point products. This with an objective of identifying weaknesses and remedying them in future programmes.

The consultancy appointed to undertake this Quality Assurance study is Rural Water Supply Ltd., (“RWS Ltd”) – which has prepared this Review Report. The basic Scope of Works was:-

• Review procurement procedures for contracting drillers/suppliers
• Review procedure roles and responsibilities of the various stakeholders involved, for borehole construction from siting to commissioning
• Conduct spot checks on all critical procedural aspects and identify key weaknesses
• Check the quality of construction of the completed drilled boreholes at random and check history of construction procedures to highlight strength and pin point any weakness that may have led to good/poor quality for at least 20 percent of the 500 boreholes
• Check management by the users, which can be linked to inadequate training / support
• Prepare practical recommendations to improve the procedure and present to stakeholders for discussion and input and then to finalize the review process with an overall recommendation report
2 OVERVIEW OF FIELD CHECKING EXERCISE

In the period Aug – Nov 2011 RWS Ltd carried out a quality assurance review of UNICEF drilling programmes including a 20% sample of 500 constructed boreholes\(^1\), a broad review of tendering procedures, stakeholder participation (particularly within district) and construction and WPC training procedures (at live sites).

102 existing borehole structures (selected at random) were visited in the six districts selected (Mzimba, Nkhatabay, Lilongwe, Mchinji, Blantyre and Mangochi). As can be seen from the Chart below these are all recent, drilled since 2007. Indeed the average age is less than 2-years. Due to this a very high functionality was expected. At the same time the corresponding 102 WPCs were interviewed as well as the WMA accompanying the survey team and other stakeholders encountered on circuit.

![Number of boreholes checked by year constructed](chart1.png)

The construction work of all 13 contractors engaged under WASH was sampled. 10 of these same contractors were also interviewed in company office (WDC omitted).

![Number of boreholes checked per Contractor](chart2.png)

---

\(^1\) 500 boreholes had been constructed at the time the consultancy ToR was written in 2010. By end of 2011 the number of boreholes constructed under the entire 14-district WASH programme exceeds 2,000 with at least 900 of these in the 6 districts falling under this review (source: contractor interview). Thus although a 20% sample was designed (2010), 11% was achieved (end-2011).
This review seeks not only to get an overview of product variability and discrepancy by contractor but also by contract agents (UNICEF, MoIWD and District) and lastly district variability. The following Chart shows that 46% of the boreholes checked were drilled under direct UNICEF contract, 33% by MoIWD and 22% by the districts. A single site for UNICEF-funded CPAR in Nkhatabay District slipped into the data set. 17 sites were checked in each of the districts making a total of 102 sites in total.

Many observations and measurements were made at the borehole site (including WPC interview) which allow the appraisal of the water source, borehole, hand pump, WPC management and the drilling contractor as well as the overall delivery process. Direct observation included whether or not the borehole is used and if so whether the water is used for drinking. Direct measurements included:-

- On the resource: Depth to water, water quality
- On the borehole: Depth of casing, GPS coordinates (screen position not possible)
- On the hand pump: Depth installed, pump timing, leakage test
- On the civil works: Verticality of pedestal, concrete hardness, drain length.

From interview, observations and measurement it was possible to create this detailed report. For the analysis and statistics the reader is referred to Sections 4 to 7. EXCEL summaries of constructional and WPC software criteria are presented in Annexes A5.1 and A5.2.
3 PROCEDURE AND METHODOLOGY

3.1 DISTRICTS VISITED

The districts visited under this review are shown in the Table below. These represent a sample of the 14 districts currently under the UNICEF WASH programme in Malawi.

<table>
<thead>
<tr>
<th>Region</th>
<th>District</th>
<th>Consult DCT members</th>
<th>Local stakeholders consulted</th>
<th>Number of existing water points surveyed</th>
<th>Spot checking live projects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CBM</td>
</tr>
<tr>
<td>Northern</td>
<td>Nkhataba</td>
<td>✓</td>
<td>10</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Mzimba</td>
<td>✓</td>
<td>8</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>Central</td>
<td>Lilongwe</td>
<td>✓</td>
<td>7</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Mchinje</td>
<td>✓</td>
<td>9</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>Southern</td>
<td>Blantyre</td>
<td>✓</td>
<td>7</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Mangochi</td>
<td>✓</td>
<td>7</td>
<td>17 + 2*</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td></td>
<td>48</td>
<td>102 +2*</td>
<td>0</td>
</tr>
</tbody>
</table>

* Two boreholes +/- 10 years old were checked for competitive purposes

The DCT members consulted in the districts were variable – influenced by availability at the time of visit of the Team Leader. The DPDO, HEHO, DWO, M&EO, DCDO and others were targeted. The exact consultation list is presented in Annex A2.2.

The local stakeholders consulted in the districts were again variable – influenced by who was available at the time of visit of the survey crew to the selected water points but those targeted were WMAs, CDAs, HSAs, AMs, BMOs, GVH and members of the WPCs and VDCs among others. The exact consultation list is presented in Annex A2.3.

The NGO CPAR was visited in Chinteche, Nkhatabay District as they have been coordinating UNICEF WASH boreholes for almost a decade.

The districts were selected by UNICEF. The water points checked within these districts were selected by the Team Leader using contractor construction reports and other summaries found at the UNICEF and NWDP offices, at the contractor offices and at district assembly offices. The water points were selected according to the following parameters:-

a) Based on random selection (every third/fourth entry)
b) Based on availability of invoice and complete construction details (i.e. siting report, water quality report, construction report, test-pumping report, civil works and installation report).
c) Based on sampling three or more of the T.As per district,
d) Based on sampling all three contract styles (i.e. by MoAIWD, UNICEF or District)
e) Based on capturing data from/concerning all implementing contractors

A list of 25 or so water points for checking per district was generated. The Field Coordinator then selected from these lists according to c), d) and e), discarding far or inaccessible sites (due to fuel
shortages). By the described process it is believed that all generated data from the sites is both random and statistically representative of the entire 2,000+ borehole data set.

The main difficulty encountered was related to b) above - that of finding complete lists / libraries of boreholes implemented thus far. It was hoped that gaps encountered at central level (UNICEF / NWDP) would be filled by consulting the files at the district assemblies. In the event all the districts had equally patchy records. Some of the record gaps were overcome by consulting the files at the offices of the Contractors. Establishment by districts of complete paper and electronic libraries is essential to district management of rural water supply – some recommendations are made (review matrix in Annex A1.3).

### 3.2 CONTRACTORS

The Table below shows the Drilling Contractors that have been checked in the districts – either by examination of existing water point or by live-checking of construction site. It also shows that visits to 10 of the 13 central offices for the contractors were also made.

<table>
<thead>
<tr>
<th>Drilling Contractor</th>
<th>Abbr.</th>
<th>Office consult</th>
<th>Existing sites checked</th>
<th>Live sites checked</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Central African Drilling Company**</td>
<td>CADCO</td>
<td>✓</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2 China Gansu Engineering Corp.</td>
<td>CGEC</td>
<td>✓</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>3 Chitsime Drilling*</td>
<td>Chits</td>
<td>✓</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4 Commercial Drilling</td>
<td>CD</td>
<td>✓</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>5 Hydro Water Well</td>
<td>HWW</td>
<td>✓</td>
<td>10</td>
<td>✓</td>
</tr>
<tr>
<td>6 Keiretsu Drilling</td>
<td>KD</td>
<td>✓</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>7 Master Drilling Company</td>
<td>MDC</td>
<td>✓</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>8 Saifro</td>
<td>Sfro</td>
<td>✓</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>9 Select Drilling*</td>
<td>SD</td>
<td>-</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>10 Tropical Drilling</td>
<td>TD</td>
<td>✓</td>
<td>3</td>
<td>✓</td>
</tr>
<tr>
<td>11 Universal Borehole Drillers**</td>
<td>UBD</td>
<td>-</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>12 Water Boring Contractors</td>
<td>WBC</td>
<td>✓</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>13 Water Drilling Contractors</td>
<td>WDC</td>
<td>-</td>
<td>8</td>
<td>✓</td>
</tr>
</tbody>
</table>

*/** different business names but under same management
4 GENERAL REVIEW

4.1 FUNCTIONALITY AND USE.

The Chart below shows that 95 (93.1%) of the 102 boreholes checked were fully functional and used at the time of survey whereas 7 (6.9%) were not. These latter are categorized:-

a) 3 had minor hand pump problems easily repaired by WPC.
b) 1 had a cracked riser pipe only repaired by an experienced AM
c) 3 had pump barrel submerged in silt
c) This is related to poor contract management. Rehabilitation may assist but due to the severity it is surmised that they are all write-offs. The underlying problem is that the contractor used the wrong drilling technique at too narrow a diameter in a very unstable formation (Section 5.4).

![Number of handpumps functional and non-functional](chart.png)

4.2 YIELD AND QUALITY.

The next Chart shows that 76% of the communities are satisfied with their new water point whereas 24% are not. The problems have been categorized:-

a) 4 report non-potable water – indeed they are outside WHO for salt (3) and Iron (1)
b) 3 report of excessive sediment – indeed boreholes were abandoned / beyond repair
c) 3 others report of “bad tasting” water^2^d) 11 report waiting excessively for water recovery, i.e. very low yield
e) 1 reports of seasonal yield – i.e. it dries in the hot, dry season

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^2^ Reports like have to be vetted because they rely on subjective taste. These 2 are justified because the water quality was measured in the range 1,500 – 2,700 uS/cm which is “brackish” in terms of salt content. Some other water points registered in the same range but those interviewed chose not to report. When suspected iron content was also checked with a Hanna Checker Disc.
These are very real problems - identified by the beneficiaries. Although 76% are functional and potable (i.e. successful) the other 24% are either abandoned (3% - shaded purple) or are pumping water of low yield or poor quality (21% - shaded red and pink). The users of these 21% have variably, often totally, reverted to traditional sources for drinking water. The less obvious problem here is that premature hand pump failure and/or abandonment will strike within this 24% from the current 7%³. The reasons why these water points were commissioned is rooted in policy and contract loopholes as well as poor contract management, notably on-site supervision – all of which allow water quality and drilling flaws to be “overlooked”.

³ There are other areas where premature failure can and does strike boreholes with good quality and yield – see Sections 5.65, 5.7 and 8.43
5 REVIEW OF CONTRACTORS AND PRODUCTS

5.1 BOREHOLE SITING

5.1.1 METHODOLOGY OVERVIEW

The contractors charge for borehole siting at their specified rate\(^4\). The Chart below indicates that about half the sites are chosen using low-cost siting methods comprising bent wires, sticks or even soft drink bottles (all known as “divining”) whilst the other half are sited geophysically (predominantly via resistivity sounding). Close inspection of the final construction reports variably produced by the Contractors often include a 1-page graphical siting report – as produced by the VES method of geophysical siting. The cable reels (and data points) are seldom rolled out more than 40m either side of the operator – which would probe ground conditions to no more than 25 meters under ideal and resistive ground conditions. VES are also point measurements – investigating the conditions below a single point feature chosen by the eye of the surveyor – e.g. commonly near a big tree or a termite hill – within the preferred community areas. Consequently the data gained from a single point / shallow depth does not investigate ground water potential of a community or school area to any degree at all. Basically the Contractors are just performing to convince those that watch that they know what they are doing. Indeed the WPCs also report that the time spent checking and deciding the drill site seldom takes the Contractors no more than 30 minutes\(^5\). Obviously the WPCs cannot provide the detail to analyse this topic further.

These findings merely reinforce what has been suspected for a long time and the obvious need to re-work the siting philosophy of the contracts. However it is very odd that the Contractors follow this path considering they are only paid for wet holes and most of them can inform of an area or areas or districts

\(^4\) ranging 20,000 – 48,700 in the 4 MoIWD contracts reviewed

\(^5\) There are few exceptions. HWW for example has been trying more detailed surveys in some districts – the technique employed are better but still far from adequate. Some other contractors have tried out the ABEM WADI as an alternative to VES but this also has very shallow ground penetration and the frequency it utilizes is notoriously fickle in reception.
where they expect many dry and unpaid boreholes\textsuperscript{6}. It could be that they are not conversant with the improvements that can be made. It was attempted to ascertain the number of dry or aborted boreholes drilled within the 102 visited communities – but this proved difficult due to many “don’t know” responses from the locals. 21 definite failures were recorded and it can be surmised that the success rate of the contractors varies from low to high, area to area but averages out at approximately 75%. This seems to agree with the records provided by the contractors which indicate a 27.5% failure rate (Section 5.9)

The survey also looked at borehole position. A good finding is that the majority of communities provided some preferred sites to check and that the eventual borehole is within these areas in the majority of instances. Most hand pumps were found to be in suitable open-space although some were found amid dense housing and, in one instance, within a busy trading center – which are poor sites in terms of pollution potential. Only 3 registered an avoidable pollution source within the contract stipulated 50m radius (latrines and graveyard). Another had a large tree 1m off the pump slab – hardly a pollution source but the tree roots are likely to divert down the bore and cause problems.

There seems to be general confusion at community level over the selection of “3 preferred sites”. This of course should be “3 preferred areas” each measuring for example 100 by 150m – giving the survey crew the possibility to profile and spot check sites within the areas for the optimal results. The communities however often place pegs in the ground – presenting very little flexibility in terms of movement. Moving 10 or 50m off their peg often causes controversy. This basic problem probably must have quite an impact on the drilling success rate – particularly in the difficult areas.

5.1.2 **Consequence of Poor Siting**

Does poor borehole siting affect hand pump sustainability? The answer is that it most certainly does. Without going into great detail the following points are made:-

- When dry meters are unpaid there is great temptation by the contractor to maneuver the borehole position to a point with visually better groundwater potential – this generally means down the slope toward or even into the local dambo or next to a termite mound. This is very poor practice because silt content in the pumped ground water increases in the direction of the dambo and close in to the termite mound – which means the resulting hand pump is prone to siltation and with such can fail prematurely. Fortunately no record of a borehole in or near a dambo was recorded for WASH boreholes although this has happened a lot on previous interventions.

- There is a similar temptation by the contractor after one or two dry drilling attempts to convince the community that a small quantity of intersected water is in fact sustainable. Section 5.2 has already indicated that 12 of the 102 boreholes checked has an unacceptably low yield – which is evidence enough that this temptation is practiced and acceptable to supervisors\textsuperscript{7}.

5.2 **Borehole Numbering and Coordinates**

A clear, durable identification number on the civil works is essential such that those that need the borehole information in the future can use it to locate the data within the relevant paper or electronic archive at the DWOs office or elsewhere. The borehole information can be used for national water

\textsuperscript{6} Among these are Mwanza, Neno, Blantyre, Mzimba, Ntchisi, Dedza, Ntcheu Nkhatabay, Chitipa and others.

\textsuperscript{7} The siting may be at fault. It could also be that the contractor has not managed to fully penetrate the aquifer – i.e. the borehole is too shallow, or, indeed a combination of poor siting and shallow drilling.
resource management, hydrogeological mapping or local resource exercises. It can also be used to
trouble-shoot and resolve any abstraction problems experienced by users. These very important issues
- often of national importance - cannot be done from almost illegible, confusing borehole details
scratched in the cement at the end of the wash stand.

It is also essential that the borehole coordinates are recorded. This can be done via water mapping
exercise post-drilling or during water point construction, recorded by the contractor on the construction
report. The latter method is more desirable.

Of the 102 water points checked 90 had no identification number at all whilst the remaining 12 had
some abstract identification scratched on the end of the wash stand. These are already weatherworn
and are likely to become illegible within a few years. Not a single water point displayed a simple,
durable identification number (photos below)

Similarly borehole coordinates were seldom found on the construction paperwork of the contractor. A
few did record them but the majority did not. Some of the siting sheets, where included, have
coordinates but these differ between the various survey sites and to back-track for a coordinate to
identify a borehole found in the field would also require investigating the community to find out how
many sites were drilled before success was achieve – a scenario of confusion.

Water point identification WASH project.
Number present but abstract

Durable, simple water point ID plate
TA Chowe No. 167
(Not a WASH borehole)

Water point identification WASH project.
No ID Number

ID plate embedded in wash stand
TA Katuli No. 406
(Not a WASH borehole)
5.3 BOREHOLE DEPTH

5.3.1 DESIGN DEPTH

The minimum depth for an AFRIDEV borehole could be 50 meters. This is particularly relevant for boreholes that yield on the low side – as it allows the pump to be adjusted to maximum setting (42 to 45m) whilst still maintaining a silt trap (sump). Boreholes with yield demonstrably higher than 1 l/s can be of lesser depth although less than 35-40m is not advisable.

Many rocky areas in Malawi have deeper water strike depths which once penetrated allow the groundwater to rise to levels which can reliably sustain a hand pump – thus drilling beyond 50m is often indicated. Maximum depth could be 60, 80 or even 100m – depending on area.

Some drilling contractors fail to grasp these concepts and continue to drill shallow boreholes with average depth in the range 29 to 40 meters\(^8\). The Chart below presents the trend. 9 of the 12 boreholes with low yield problems referred to in 4.2 above are less than 45m deep.

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\(^8\) CDC, MDC, WDC and UBC all drill boreholes on the shallow side
5.3.2 Invoiced Depth

Comparison between invoiced and measured borehole meters reveals a notable discrepancy. The Chart below should be compared to the number of boreholes drilled by each contractor in Section 2. Where more than 4 boreholes have been drilled by a particular contractor an average of 1m or less discrepancy between invoiced and actual borehole depth could be attributed to post-drilling siltation. Averages >1m set off an alarm.

![Discrepancy between invoiced and measured meters (averaged per borehole)](image)

Saifro and Chitsime with a combined total of 38 boreholes checked show greatest integrity in that the average deviation is well under 1 meter. This could be honest measurement and/or good drilling and development techniques which would remove most of the silt from the formation and arrest significant subsequent sump-filling.

Seven of the remaining 12 contractors have discrepancies that average >2.5 meters. Sometimes the drilled depth rather than the cased depth is claimed (Contractors are apt to break the rules in this respect) or some siltation has occurred in the period between hand pump commission and the present time. However, dishonest invoicing also must to be involved. Indeed it has long been suspected that unpaid dry boreholes on “wet” borehole contracts will be recovered by hook or by crook.

Having stated this no definitive conclusion can be made because some of the discrepancies will be caused by post drilling silt influx to the sump. If so, the fact that 2 contractors have very small discrepancies would indicate that the 7 contractors that have large discrepancies may practice very poor development procedure (Section 5.5 - development). They may also lack the capacity to change from air-percussion to mud-rotary technique in loose saturated formations (air-percussion exacerbates silt influx). These are the same contractors that also have lesser average depth indicating again that they probably do not have the technique to drill deeper when collapse problems are encountered.

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9 The borehole can collapse in the period between pulling rods and inserting casing. This happens a) in loose, saturated formations particularly when aggressive air-percussion is used and b), generally, when the PVC casings are not on site and a delay ensues.
The observed discrepancy also demonstrates that the supervision is extremely poor because the benchmark of good supervision is to mark / measure both the drilling rods and the PVC casings as they are installed and then to compare the figures to ascertain the amount (if any) of borehole collapse and the amount to be invoiced (i.e. length of casing installed).

5.4 BOREHOLE DIAMETER AND DRILLING METHOD

5.4.1 DIAMETER

The MoAIWD contract stipulates the end-of-hole diameter of 6 ¾ inch or 171mm. With PVC casing having an outer diameter of 113mm – this diameter of drilling leaves an annular gap of 29mm between formation and casing into which gravel must stabilize the formation from bottom upward. However, the recommended “text-book” annular gap is 75mm for a public water supply / ESP borehole – which can be compromised to 50mm for rural hand pump boreholes. This would be achieved with an 8 inch (203mm) drill bit – achieving an annular gap of 45mm.

In consistently hard/firm hard rock formation, boreholes of 6 ¾” (171mm) diameter that are fully gravel packed usually give long-lasting service. Problems impacting and shortening service life happen when the underground formation is completely soft and saturated (or alternating hard and soft). These hydrogeological scenarios are common to both alluvial and metamorphic sequences – the two dominant aquifers types in Malawi10.

5.4.2 DRILLING METHOD

Hard / firm geological successions should be drilled with the air-percussion technique. Soft and saturated situations should be drilled with mud-rotary technique. Mud-rotary cannot drill hard geology. Unfortunately air-percussion can drill the soft and saturated conditions – but very badly with results that impact significantly on hand pump sustainability. The aggressive air actually excavates the soft layers creating cavities and generally mixing encountered soft material and water into slurry of no use to anyone. The resulting borehole frequently collapses as the PVC is installed, gravel stabiliser seldom reaches the screened section, the installed hand pump rapidly clogs with fine material pulled from the surrounding mixture left by drilling (silt, mica, and clay). Any water pumped is usually so full of mud, silt or mica that it cannot be used. The community is powerless to remedy the situation. The same borehole and hand pump could sustain if drilled with less invasive mud-rotary drilling – at a slightly larger diameter (10” or 254mm is recommended) packed with a slightly larger volume of gravel. In fact

10 The hydrogeological conditions of metamorphic and alluvial aquifers in Malawi are at the same time both variable and also quite different from those found in other environments such as Kenya, Sudan etc. Thus studies on “cost-effective” drilling (e.g. Armstrong 2009) when they recommend narrow and shallow drilling and even open hole conditions (no casing/screen) or “lump sum” contracts will definitely impact on water point sustainability if practiced in Malawi. The proportion of boreholes of low yield and/or excessive silting is increased when such policy is practiced. The resultant hand pump may work for a month or a year but premature failure is never far away – simply because the village users CANNOT rectify such constructional flaws A better policy is to have flexibility within the contract allowing for different drilling method, diameter and depth according to the site hydrogeology and then again to have people on site with knowledge to guide and enforce contract variables.
– all drilling rigs should be equipped for air and mud drilling – allowing “combination” drilling through hard and soft layers to be done.

Borehole diameter and drilling method could not be ascertained during field survey. However, inspection of construction reports indicates that 6 ¾” and 6 ½” (171 and 165mm) drill bits and the air-percussion method were predominant. The narrow 6 ¾” (171mm) diameter combined with incorrect drilling technique (air-percussion) through very soft, saturated, often micaceous conditions have most definitely impacted on water point sustainability in a few instances. Clear indication of this is seen with three boreholes surveyed which revealed the hand pump cylinder completely clogged and submerged in silt (Chart in Section 5.2, photo below). These three boreholes are shared between Nkhatabay and Mangochi districts and between highland / metamorphic and lakeshore / alluvial aquifers. At least five other boreholes indicate that silt infilling of the sump is nearing pump intake and hand pump failure will occur at some point in the future.

![Footvalve / cylinder packed with silt](image)

Footvalve / cylinder packed with silt
Borehole by UBD (2010) – used 2-days only!
Pila II, Mangochi.

![Can’t fish the footvalve due to silt in cylinder](image)

Can’t fish the footvalve due to silt in cylinder
Borehole by WDC (2010) – used 1-month!
Chankhu, Nkhatabay

Again these observations indicate that supervision is not able to comprehend / advise corrective procedures to the contractor. The situation is not helped by the lack of clear instruction in the contract specifications, particularly those of the MoAIWD.

All four instances of excessive silting occur on MoAIWD/District contracts rather than direct UNICEF contracts. It is worth noting that the former contract specifications do not mention alternative mud-rotary drilling and/or larger diameter drilling whereas the latter contracts do (p. 8-9 UNICEF 2007a).

### 5.5 Development and Yield Testing

The WPCs were asked if the Contractors had firstly carried out development procedure and secondly yield testing. Most confirmed that both had been executed but often went on to say that the duration was very short. The upper Chart below depicts development done (regardless of short – 15 minute - or normal– 3 to 4 hours – duration) and development not done - for the 102 borehole sample. The lower Chart depicts the same for yield testing.
The Charts indicate that most contractors develop and yield test their boreholes – at least to some degree. A minority of contractors are erratic in that some are done and others not. It is noticeable that the culprits are the same in both instances. It is also noticeable that the three high volume Contractors on the direct UNICEF contracts are generally consistent and good (Saifro, Chitsime and Hydro Water Well). The high volume contractor on the MoIWD contract (CADCO/UBD) needs to improve.

The Chart below shows the percentage of low yield boreholes of total drilled / visited - per contractor. Those above 50% are probably not very accurate as they have only been checked at 2 or 3 sites – nonetheless there is an indication. Here the high volume contractors are variable with Saifro on the UNICEF contracts having a zero incidence of low yield whilst Chitsime, HWW and CADCO / UBD vary 10-25% - meaning there is definitely room for improvement.
Low yield is a big problem facing Contractors’ district supervisors and users. It is abundantly clear that WMAs, do not know how to judge yield test results. 12 of 102 visited boreholes have been “approved” for use despite having a very low or erratic yield – which is constantly aggravating the users. 11 of these 12 boreholes were subjected to a yield test (according to the WPCs).

Likewise three boreholes are abandoned due to silt choking the pump mechanism. This silt would definitely be seen during drilling, development and yield testing. How the WMAs missed this and approved the boreholes is beyond comprehension.

Abandoned borehole choked by silt influx
Madyaka II, Nkhatbay
5.6 CIVIL WORKS

5.6.1 CONCRETE QUALITY

Using a Schmidt rebound hammer the concrete strength of all civil works was checked at 5 consistent places on the civil works and the readings averaged per unit and then per contractor. These averages are shown graphically below compared to the documented strength of a “B25” concrete suitable to an outside, weathered exposed position (green bar).

![Average Concrete Strength Measured as a % of a "B25" Weather-Exposed Concrete Slab (38MPa or 100%)](image)

All test averages register at less than half the recommended strength. Some contractors cast concrete at less than 20% the recommended strength.

Concrete strength is controlled by the quality, quantity and mixing of the 3 main components: cement, stone and sand and the recommended mixing ratio prescribed by the contract (respectively 1:2:4). According to the documented diagrams the civil works require hard durable concrete slabs having a combined volume of 2.8m³. The diagrams also indicate an underlying bottom layer of blinding concrete and intermediate layer of brick or rubble – these latter two layers are predominantly absent at field sites. The 1:2:4 mixture is equivalent to standard / international “B25” and this requires 300kg of cement powder per cubic meter of concrete. Thus the number of 50kg pockets of cement used per borehole site should be at least 25 (Table below)

<table>
<thead>
<tr>
<th>Civil works component</th>
<th>Volume (m³)</th>
<th>Grade</th>
<th>50kg Pockets</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Weather exposed concrete slabs</td>
<td>2.8</td>
<td>B25</td>
<td>18</td>
</tr>
<tr>
<td>2 Foundation screed (or “blinding”)</td>
<td>+/- 0.2</td>
<td>B10</td>
<td>4 +</td>
</tr>
<tr>
<td>3 Sanitary seal</td>
<td>+/- 0.5</td>
<td>slurry</td>
<td>2</td>
</tr>
<tr>
<td>4 Brickwork and finishing</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Chart below shows that the contractors are using less than 12 pockets of cement in the civil works. This explains the very low concrete hardness values referred to above. Indeed this is typical practice at unsupervised construction sites whether it is for buildings, boreholes or other structures. The 1:2:4 mixing ratio is applied incorrectly and deliberately to maximize profit margins by:-

- Confusing weights with volumes i.e. one bag of cement (weight) with 2 wheel barrows of sand (volume) with 4 wheel barrows of aggregate (volume). With this scheme it should also be 1 wheel barrow of cement (or 2 pockets). With this volume only scheme in place “B25” would be attainable and approximately 25 bags of cement consumed.

- Currently a weak “B10” or blinding concrete slab is cast where there should be a strong “B25” concrete slab. Further the surface of the weak B10 slab is then plastered with neat concrete powder to achieve a hard skin that camouflages the weak slab underneath. This methodology may be acceptable for internal flooring but is not suitable for external, weather-exposed, concrete foundations.

![Average bags of cement per civil works by Contractor (WPC report)](chart)

### 5.6.2 Reinforcement of Concrete

The following two Charts show that many Contractors do not reinforce the concrete. Where the concrete is weak, as already shown, this leads to rapid erosion, crack extension and general deterioration (photos). Those that do reinforce seem to be on a direct UNICEF contract with the need for such spelt out clearly in the contract documents (p. 6 UNICEF 2007) whilst those that don’t use reinforcement seem to be on a contract format originating from MoAIWD – which makes no mention of reinforcement.
CWs 1: Skin peels off exposing the weak-mix “B10” slab to weathering. Mwera, Lilongwe

CWs 2: Poorly finished basins Chigoti, Mangochi
5.6.3 CIVIL WORKS DIMENSION AND STYLE VARIATION

A significant variation in the size of the civil works is registered particularly in the length of the drain – but also in the width and size of the apron. The Chart below shows drain length variation averaged per Contractor. It is clear that some of the variation should be due to whether it is with MoAIWD / District or UNICEF contract – as there is a difference in the specification (green bars). However when the data is analysed, per contract administrator, this expected difference is not seen at all (Table in Section 6.2). The probable reason is that the contractors made up shuttering to cast the slabs and drains some years ago and have not made new ones to suit the longer UNICEF design – and, of course, nobody has noticed (supervision issue).

However, 7 Contractors average less than the MoAIWD specification of 7.6m and 2 Contractors average less than 5 meters. There are also variations on the style of the civil works e.g. square pedestal plinth and wash stand that are sometimes absent or sealed, etc., (photos). Some communities don't want a washstand and request that the contractor not build it or build it without basins. Others block the basins with soil or stones post construction.
CWs 5: Plinth absent, small apron and drain
Tropical Drilling, Tauseni, Lilongwe

CWs 6: Neat civil works, no wash stand
washstand, Nthulinga, Nkhtabay

CWs 7: Square plinth around pedestal,
Post Masulani, Blantyre

CWs 8: No basins in wash stand,
Katapwito, Mangochi
5.6.4 OTHER CIVIL WORKS ANOMALIES

A number of other common civil works anomalies are highlighted in the bulleted points and photos below:-

- **Pedestal off-vertical**. This puts a side stress or bending force on the rods causing them to rub on and sometimes cut through the riser pipes in severe cases. The pedestal was found off-vertical at 25 of the 102 sites and 4 of these were off-vertical by more than 2cm – which is regarded as a serious construction flaw promoting premature hand pump failure.

- **Pedestal loose in concrete block**. This is caused when the contractor allows the users access to operate the pump whilst the cement is still wet. The hand pump will fail rapidly when the pedestal rocks excessively. The opening around the base of the pedestal will also present a direct pollution route to the aquifer. The users often fill the gap with cement – but the swaying to and fro tends to recur. The best method of preventing this from occurring is to cast the concrete footing to the pedestal as well as the apron slab in one unit and not allow the users access for at least 7-14 days. Pedestal rocking was observed at least 4 times at different sites from the above and this is regarded as a serious construction flaw promoting premature hand pump failure.

- **No drain pipes on wash stand**. The simple PVC pipe inserts were missing on so many of the sites visited – particularly Mzimba District. This does not have a bearing on the sustainability but can accelerate the erosion of the washstand itself. Two washstands observed in Mangochi District had the drain pipes in place but on the side opposite the drain.

- **Ponding of waste water**. Waste water was found ponded on the apron or drainage channel at a number of sites checked – meaning that the contractor had failed to create the required slope along the entire length and breadth of the construction. This does not have a bearing on the sustainability but does present a health and hygiene hazard.

- **Absent or incomplete soak-away** (see Section 7.4.4)

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**CWs 9: Pedestal rocking in concrete, Chiganga, Nkhatabay**

**CWs 10: Ponding of water on pump slab, Gwirani, Mchinji**
5.6.5 Hand Pump Installation Anomalies

During the process of dipping the borehole for depth the pump, risers and rods were first removed from the borehole. This presented the opportunity to inspect the various parts. Some abnormalities were found – related to contractor procedure and others related to WPC or AM maintenance. Those related to the Contractor can be divided into two categories (photos):

- Abnormal wear on rod centralizers and riser pipes. This can be interpreted in two ways – firstly it could be that the contractor is using second-hand items when installing in a few boreholes. Secondly the observed wear can be produced when the borehole rods and risers are curved in orientation. In other words the Contractor has drilled a crooked borehole and nobody has noticed. At least three sites are suspected where this might be the case. If so, these boreholes will suffer failure at some point in the future which the WPC and local AM may not be able to fix.

- Use of sawn riser pipes. This was witnessed at two sites with all the riser pipes sawn at the original socket, different colours and types and connected together with “waisted” double sockets. Two problems are inherited. First the contractor has broken the rules by installing second hand components. It may be that they were installed and sawn when removed either on site or from another site – which is not an excuse. Second the waist on the socket causes the rods to catch, particularly in slightly bent boreholes – making maintenance difficult or impossible. These hand pumps can fail prematurely.
• Risers not pushed together sufficiently. This was noticed at two sites and repaired. In the photo below the overlap is less than 3cm whereas it should be more than 10cm. The result is that the pipe easily dislocates and when this happens during hand pump operation the pipes and cylinder often drop down the boreholes and the hand pump is abandoned.

• Incorrect timing of plunger in cylinder during installation. This causes the plunger to knock on the underlying footvalve with damage to both. There are 4 plunger / foot valve types and the effect of bad timing varies between them (Section 5.7.2). In the example given (photo) the damage is severe and fishing of the footvalve to replace the valve or seal is not possible unless the WPC or AM know how to Mphanda the riser pipes complete. In all likelihood the borehole will be abandoned when the footvalve fails. A common indication that timing is poor is seen on the plastic plunger and plastic footvalve arrangement when either has missing or broken legs. These missing limbs often get stuck under the footvalve seat causing leakage and poor/zero pump yield. In most instances this scenario can be rectified by normal WPC fishing processes. To reduce these potential failure paths the timing must be done properly by the Contractor during initial installation.
• Not shown but worth mentioning are a few boreholes where some of the outer riser pipe centralizers were absent (should be installed one on each riser pipe). Again, this is a very serious omission by the Contractor as it leads to pipe and rod flexing, vibration and premature failure.

Once again these observations indicate that site supervision is not able to comprehend / observe or witness such installation abnormalities.

5.7 HAND PUMPS

5.7.1 BRANDS

The Chart below details the numerous hand pump brands noted during survey. Most have a name plate on the pedestal indicating the manufacturing company – which in the majority of instances is a company based in India – these are all “big brand names” which means (in theory) that all components are fabricated, machined and matched under a single factory roof – which promotes hand pump sustainability. One brand found at 6 sites appears to be local (Polyplast of Blantyre) – but this is probably an intermediate supplier with the parts imported. Ten sites are “no-name” brand in that there was no name plate.

![Analysis of hand pumps - by brand name on pedestal](image)

Very little in the way of specification for the either the hand pump or the riser pipes is given in the various contract documents – leaving the door wide open for substandard brands and components to invade Malawi. This does not seem to be happening to any significant degree at present\(^1\). However there is reason for concern as problems that can and do impact on hand pump sustainability have physically been identified in 5-10 instances – these can roughly be divided into 3 categories:-

a) Non-standard application of components (covered under Contractor, Section 5.6.5)
b) At least 4 different cylinder assembly arrangements – requiring different styles of fishing
c) Components with defects which lead to premature hand pump failure

\(^1\) One of the contractors attending the Stakeholders Review Workshop stated that this problem was occurring on imports into Malawi
### 5.7.2 Multiple Cylinder Arrangements

The Table and Photos below indicate the four cylinder arrangements found during survey. The seals within the cylinder are common to all these variants. Arrangement 4 often has problems with leakage because silt settles on the footvalve seat and the brass footvalve merely sits on this whereas the plastic equivalent clicks into place with its legs. Tried and tested arrangement 1 can be purchased to replace all others if the parts wear out and no spares are found locally. Having expressed this – having so many variants can hardly be described as promoting sustainability – indeed maybe the opposite.

<table>
<thead>
<tr>
<th>Cylinder variant</th>
<th>Frequency</th>
<th>Method of fishing</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Plastic plunger, plastic footvalve</td>
<td>Most common</td>
<td>Standard Rev 3 fishing tool</td>
<td>Most WPCs could fish the footvalve unaided</td>
</tr>
<tr>
<td>2 Brass plunger, plastic footvalve</td>
<td>Occasional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Threaded brass plunger, plastic footvalve</td>
<td>Common</td>
<td>Lower rods and revolve to screw onto (fish) the footvalve</td>
<td>Only a few of the WPCs knew how to fish the footvalve</td>
</tr>
<tr>
<td>4 Threaded brass plunger, brass footvalve</td>
<td>Occasional</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Arrangement 1  
Plastic plunger and plastic footvalve  
(fishing tool required)

Arrangement 2  
Brass plunger (and plastic footvalve)  
(fishing tool required)

Arrangement 3  
Brass threaded plunger and plastic footvalve  
(fishing tool not required)

Arrangement 4  
Brass threaded plunger and brass footvalve  
(fishing tool not required)
5.7.3 DEFECTIVE COMPONENTS

During pump removal for depth measurement a number of defective parts were witnessed. These are shown in the Photos below and briefly described herewith.

- **Defect 1.** Hook-end of the rod tends to shear across the thin part of the hook. This is due to imperfections as the casting cools. Better quality hooks are machined and not cast.

- **Defect 2.** Nut sheers off either the hook-end or the eye-end of the rod due to imperfect welding.

- **Defect 3.** Pivot and fulcrum pins are made of mild steel with a sleeve of stainless steel – which runs in the nylon bushing. With continual operation this sleeve is apt to burst and handle operation to become noisy. If the pins are not replaced then both the bushes and the handle wear abnormally fast and breakdown occurs. Manufactures can machine solid stainless steel pins at lesser cost – and these do not suffer the same problem.

- **Defect 4.** Sleeve in the handle assembly is poorly fitted and becomes loose, rotates and then wears abnormally fast.

These defects have each been observed at least 3-times each.
5.8 CONSTRUCTION REPORTS

Construction reports should contain the following basic sheet inputs per borehole:-

- Geophysical siting - graph and interpretation
- Construction log borehole, hydrogeological measurements, coordinates etc.
- Penetration log
- Development and yield test data, (possibly a basic time-drawdown graph)
- Civil works and installation data sheet
- Water quality analysis (from laboratory)

The style of the submitted construction reports vary from quite smart with graphical presentations of geophysics and pump testing to quite scruffy, hand-written submissions. Generally the relevant data is present but notably a number of Contractors do not present the geophysical siting and/or the water quality analysis from the laboratories.

It is noted that a few Contractors do give the DWO a summary table of borehole data – usually upon request.

Most of the contracts are direct from either UNICEF or MoAIWD. Final construction reports are delivered as one original and 1 to 3 copies. Unfortunately the copies intended for the districts are not being delivered.

Construction report format and infallible delivery to critical stakeholders needs to be reviewed. The Stakeholders would be:-

- UNICEF (1 copy)
- MoAIWD – Water Resources Board (1 copy)
- MoAIWD – NWDP (1 copy)
- District (2 copies)

5.9 CONTRACTOR VIEWPOINTS

Ten of the thirteen Contractors drilling on WASH contracts were interviewed at their main offices. The following points were advanced:-

- **Supervision.** District supervisors are supposed to be on the various construction sites to approve and countersign the worksheets. Generally the Contractors maintain that district supervision is workable. However, supervisors frequently claim to have no money for transport (fuel for motorcycle) or for accommodation in the field where the district is very large (e.g. Mzimba). Often they are absent from site and the contractor continues unsupervised. In other instances the supervisors corner the contractor to provide funds and the contractors tend to oblige as they wish to proceed and fear difficulty in the counter signing of the worksheets by same individuals.

- **Delays.** One Contractor mobilised to Mangochi District and had to wait for more than a week for the DWO to produce the list of sites to drill. In other words sometimes the districts are not ready for the
Contractor. This tends to happen when the contract administrator is either UNICEF or MoAIWD and not to happen when the administrator is the district.

- **Favours.** One contractor executing a large contract says that the level of "favours" requested by the districts is very high with some much more at fault than others. Another contractor mentioned that water points were up-for-sale by unscrupulous district employees on the black market in one district (MWK 50,000). Most of the contractors strongly believe that bribery by other contractors is rife during the tendering and award process – particularly when the award is by the district.

- **Cement.** Two contractors stated that the policing of cement at civil works sites is one of the biggest headaches. According to these two contractors the district supervisors, civil work teams (i.e. their own staff) and even the WPCs are guilty at times in misappropriating pockets of cement for personal gain. These comments are more than likely accurate as cement is a highly desired material which is abused on most developing-world construction sites – more so where the supervision is either absent or dishonest. One Contractor said that the problems and logistics reduced when they sub-contracted the civil works to a dedicated civil works sub-contractor.

- **Dry boreholes.** All contractors grind the axe over non-payment for dry boreholes. Two contractors provided accurate dry borehole statistics for a combined total of 448 served communities and 123 aborted drilling attempts which computes a statistically valid 72.5% success rate. All 13 contractors indicated a total of 1,497 boreholes drilled under WASH thus far. Applying the above success rate it means that at least 1,908 boreholes have been drilled to get success in 1,497 communities (i.e. at least 411 dry or aborted drilling attempts). This has a serious cost attached – born totally by the Contractor. Based on Contractor comment districts can be ranked good, medium, bad and very bad in terms of success rate (Table below). It should be noted that this is only a guideline and does not cover all districts. It should also be noted that there is considerable variation from good to very bad within each district. As a general rule escarpment and adjacent upland terrain is ranked bad whilst lowland, lake shore and flat highland plateau areas are ranked good.

<table>
<thead>
<tr>
<th>Difficulty in terms of dry boreholes</th>
<th>Good</th>
<th>Medium</th>
<th>Bad</th>
<th>Very bad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lilongwe</td>
<td>Mangochi highlands</td>
<td>Mwanza</td>
<td>Blantyre</td>
<td></td>
</tr>
<tr>
<td>Chikwawa</td>
<td>Dowa</td>
<td>Mzimba</td>
<td>Neno</td>
<td></td>
</tr>
<tr>
<td>Salima lake shore</td>
<td>Nkhaba bay highlands</td>
<td>Ntchisi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nkhotakota lake shore</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nkhatia bay lake shore</td>
<td>Dedza</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mangochi lake shore</td>
<td>Kasungu</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mchinji</td>
<td>Chitipa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thyolo</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nsanje</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Contractors do seem to have a valid point when it comes to non-payment for dry boreholes. If the ground water potential at a borehole site were compared to a sick person at the doctors’ surgery then a similarity is seen in that there is complex hydrogeology under-foot and complex biochemistry under-skin and the layman understands neither sufficiently to self-diagnose. The patient pays the doctor to do this - sometimes for several visits and several prescriptions - but recovery is never guaranteed, indeed death sometimes intervenes.
• **Sub-standard materials.** Community supply of stone, sand and water for the civil works is generally agreeable to the Contractors. However, they do state that these are frequently not provided on time or at all (in some areas aggregate is not available locally). This leads to logistical delays and incurred costs where the contractor has to either purchase and/or transport the materials on behalf of the community. The quality of the materials is also not good in many instances. For example the aggregate is larger at 25-40mm (usually hand-knapped) than the engineers recommend for excellent concrete (15-20mm) or the sand is soft or dusty whereas for good concrete it should be clean, “sharp” river sand. Quality of materials is a VERY appropriate point because sub-standard materials make less durable concrete (see also Section 5.6.1). Further, the contractors will argue that sub-standard concrete is more to do with the materials supplied by the communities than lack of cement and mixing ratio.

• **Efficiency of Payment.** Contractors singled out MoAIWD as being extremely slow to pay when an invoice is presented. UNICEF and the districts were viewed as more efficient.

• **Road Traffic.** Some of the Contractors mentioned problems with Road Traffic when returning from field activities to workshop. Their argument is that the nature of the drilling activity often saturates the rear lights with water – causing circuit failure. Subsequently they are apprehended and the officers fail to understand the situation in its real context.

### 5.10 CONTRACTOR PARAMETERS NOT MEASURED

Very little came from viewing live construction sites simply because the contractors were not active during the field visit of the consultant to the districts – due to fuel shortages. Many construction activities can only be viewed during actual construction and cannot therefore be dissected and reviewed merely from visits to completed boreholes. The areas that cannot be covered are:

- Integrity of data in the construction reports - collected during siting, drilling and yield test, etc.
- Screen type, slot-width, design and placement
- Type, grade and placement of gravel pack
- Development and yield testing
- Sanitary seal and foundation / reinforcement to civil works
- Quality and quantity of civil works materials, mixing, pouring and curing procedures

Some of these can be commented on via 3rd party observation, e.g. the WPC recollection of gravel placement or development for example, but detail on duration, dimensions, materials and competency is lacking. All of these bulleted points can and do impact on water point sustainability when not correctly executed.

### 5.11 IDENTIFIED CONTRACTOR AND CONSTRUCTION ISSUES

Review Matrix A, (Appendix A1.1) tabulates identified issues (or problems) related to the contractors and their construction techniques - which can affect hand pump sustainability in the short, medium or longer term. These are presented together with “indicators”, risk and effect and remediation suggestions. In summary the topics are:-

---

12 Consultant brought in fuel from Chipata to overcome mobility problems.
A1 Review borehole siting technique and methodology
A2 Review drilling technique for encountered hydrogeology
A3 Review borehole dimensions (diameter and depth) and verticality
A4 Review development method and technique
A5 Review yield and quality testing technique
A6 Review civil works technique and procedure
A7 Review hand pump sourcing, supply, installation techniques and procedures
A8 Review dissemination of information (e.g. construction reports and electronic summaries)
A9 Review the need for ID plates and coordinates (currently lacking)

This Matrix does not necessarily cover all issues and indeed there may be other important considerations. Some of the above topics were discussed during the Stakeholder Review Workshop along with the remedial path. These agreed topics are covered in Section 10
6  REVIEW OF TENDER AND CONTRACT PROCEDURES

6.1  TENDERING PROCEDURE

Whatever the route of contract dispensation, government entities including district administration must follow defined tendering procedures according to the tender value - available on-line at www.ODPP.gov.mw. Drilling contracts are normally above the MWK 10,000,000 threshold and this requires an open tendering procedure involving an Internal Procurement Committee (IPC) which follows a strict code of practice known as National Competitive Bidding (NCB). This code is necessary to promote fairness and transparency and to reduce/eliminate corrupt or abnormal practices.

This IPC has a flexible membership according to the type of contract. For drilling contracts the District IPC might include the DC as Controller, the DPDO as Chairperson, the DoF and/or a procurement specialist (as Secretary) together with the water specialist (usually the DWO). NCB involves the following steps:-

a)  IPC formats ToR and bid invitation. The districts use a standard designed by the MoIWD.

b)  The invitation to tender (or RFP) is advertised at national level sating a 28 day response period. Interested parties invited to collect more detailed ToR in some instances (e.g. drilling). The price of the tender documents is to cover the incurred advertising and evaluation costs.

c)  Submission of bids and public opening after 28 days, during which the bid and bid summary (usually the Bill of Quantities), the Form of Tender (sometimes with an Appendix) and the other qualification documents stated in the Tor are checked for completeness.

d)  Formation of a multi-sectorial Evaluation Team (at least 3 people). For drilling contracts it would typically include a hydrogeologist, a procurement specialist and one other member. For “Best Practice” the Chairman or Controlling Officer of the IPC is not a member of the Evaluation Team.

e)  This team evaluates – typically within the period of 1-week - and prepares a Recommendation Report which is then formally presented to the IPC.

f)  The IPC formally presents recommendation in writing to the ODPP, requesting “no objection” to Negotiate and Award. Negotiation is in terms of items, equipment, staff, procedures but not prices.

g)  Following negotiation, contractor given Draft contract for review.

h)  Final Contract signed within 28 days during which time contractor can arrange Performance and Advance Payment Guarantees if required or necessary.

i)  Contractor mobilizes within the period stipulated within the Tor – normally within 14 days.

An additional step - within the district approach - is to request and receive a second “no objection” to proceed from the donor (UNICEF).
The entire tendering period between advert and arrival of the contractor in the district is a minimum of the sum of the above tendering steps – or approximately 3-months. In practice this is often much longer due to a variety of encountered delays.

NCB is designed to be transparent and foolproof to malpractice. As one district DCT member put it “because of the very detailed nature of the NCB process it is not possible to influence other than a fair outcome”. This is debatable (see below).

6.1.1 UNICEF TENDERING

The method by which UNICEF shortlist, tender and award contracts was not investigated.

6.1.2 MoAIWD TENDERING

The tendering follows the NCB procedure described in Section 6.1. The Consultant did not review any tender correspondence at MoAIWD or NWDP.

The Contractors mentioned that CADCO scooped the entire 360 WASH borehole contract in 2009 (4 Lots). This was supposed to be completed in the same year but dragged on to the end of 2010. Some of the boreholes were drilled by Universal Borehole Drillers which fall under the same ownership as CADCO.

6.1.3 DISTRICT TENDERING

This consultancy reviewed only one set of tendering correspondence in detail. Of the 13 tenderers 7 were disqualified for late delivery or not providing a bid security (fair enough). Of the remaining 6 the most expensive was chosen but not before 4 capable contractors were disqualified for not having “district experience” (unfair elimination as all have much experience in other districts). This was specifically stated in the evaluation report as necessary owing to the difficult / collapsing drilling conditions found in the district. The successful contractor was the 2nd most expensive of the 13.

The referred 30-borehole contract took six-months between advertising and contractor mobilisation. In late 2010 the district decided to extend the contract by 20-boreholes rather than repeat the tendering process. This also required approval by both the ODPP and UNICEF which caused delays, as did cost re-negotiation based on currency devaluation and fuel price hikes. The contract extension received approval by ODPP and UNICEF but it took 8 months between starting the process and contractor mobilisation.

By coincidence the very first site checked by the survey team was a borehole drilled by the successful tenderer. This borehole is producing silt and mica and is only 30.9m deep. When drilled, too much soft material was excavated by the air-percussion technique and drilling stopped prematurely at 32m. The quantity of gravel inserted was huge (WPC report) – which means that the air-percussion had eroded large cavities in the sides of the borehole. The overall deduction is that it was drilled with the wrong drilling technique – quite the opposite from that on which the award was based. High rates of siltation coupled with shallow depth mean that this water point is a candidate for premature failure.
The point made here is that it is very easy for an IPC to award a tender to a preferred contractor by creating credible criteria by which the competition can be eliminated. Why the ODPP did not too question the elimination criteria in the above example is not known.

6.2 CONTRACTS

6.2.1 GENERAL

Various drilling contractors work under UNICEF, MoAIWD and District contracts as shown in the table below. The larger contracts are with MoAIWD and UNICEF and tend to have several districts within each Lot. The district contracts are typically for 10-30 boreholes and obviously each is restricted to a single district Lot.

<table>
<thead>
<tr>
<th>#</th>
<th>UNICEF</th>
<th>MoAIWD</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Saifro</td>
<td>CADCO</td>
<td>Saifro</td>
</tr>
<tr>
<td>2</td>
<td>Chitsime Drilling</td>
<td>Water Boring Contractors</td>
<td>Tropical Drilling</td>
</tr>
<tr>
<td>3</td>
<td>Hydro Water Well</td>
<td>Hydro Water Well</td>
<td>CADCO</td>
</tr>
<tr>
<td>4</td>
<td>Keiretsu Drilling</td>
<td>Universal Borehole Drillers</td>
<td>Hydro Water Well</td>
</tr>
<tr>
<td>5</td>
<td>China Gansu Eng. Corp.</td>
<td>Water Boring Contractors</td>
<td>Master Drilling Company</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>Select Drilling</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>Water Drilling Contractors</td>
</tr>
</tbody>
</table>

6.2.2 UNICEF CONTRACTS

The contract document is a series of data documents which are given in duplicate to the appointed contractors with one copy signed and returned to UNICEF. The documents cover the following topics:

- Document 1: Terms and Conditions of Contract
- Document 2: Technical specification and procedure of construction
- Document 3: Technical specification and procedure of installation of AFRIDEV hand pump

These documents are carefully prepared and flexible to most encountered hydrogeological scenarios and drilling conditions. The hand pump section is too basic.

6.2.3 MoAIWD CONTRACTS

The contract document is the current standard and all WASH boreholes are supposed to follow the specifications therein. However, there are some differences with the direct UNICEF contract specifications and these are compared in the following Section 6.3.
6.2.4 **DISTRICT CONTRACTS**

Some of the districts fully tender, award, manage and pay contractors whilst others do the same but instruct UNICEF to pay after invoice checking and endorsement. Only Mzimba of the 6 districts visited does not tender within district (Table below). All districts also manage, supervise, check invoices and instruct MoAIWD / UNICEF to pay contractor on central MoAIWD / UNICEF contracts.

<table>
<thead>
<tr>
<th>District</th>
<th>Tendering/award district contracts?</th>
<th>Administer check district contracts?</th>
<th>Pay contractors direct via district accounts office?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lilongwe</td>
<td>Yes</td>
<td>Yes</td>
<td>DWO not sure</td>
</tr>
<tr>
<td>Mchinji</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Mzimba</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Nkhatabay</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Blantyre</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Mangochi</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

District contracts appear to be the same as the MoAIWD format. However the Consultant did not locate a single copy of a District contract document – and wonders if in fact they are prepared and signed. Some of the DWO’s interviewed said that they did not have access to the technical specifications of contract or the various drawings – which is untenable because these are the same as MoIWD contracts – which they should have.

The Districts are tending to award the contracts to the smaller “local” contractors many of whom do not have exemplary / full technical capability. CPAR (Nkhatabay) report extreme technical and management difficulties encountered with Water Drilling Contractors of Blantyre (indeed seen in all the drilling statistics derived by this review: shallow depth, absent reinforcing, lack of development, silty boreholes, etc.). This is the same contractor recently awarded a contract by Mangochi District Assembly. The point here is that the same mistakes are being repeated without any sign of improvement - either by Contractor or by District.
### 6.3 Comparison of UNICEF and MoAIWD / District Contracts

There are many differences both subtle and bold existing between the UNICEF and MoAIWD / district contracts - as shown in some detail in the Table below. One would expect these differences to lead on to some differences in the final borehole / hand pump products – and indeed some may lead on to impact sustainability.

<table>
<thead>
<tr>
<th>Construction step</th>
<th>UNICEF</th>
<th>MoAIWD / District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Geophysical siting</td>
<td>Geophysical Resistivity</td>
<td></td>
</tr>
<tr>
<td>2 Avoiding pollution (m)</td>
<td>50</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>3 Payments per meter</td>
<td>No - lump sum</td>
<td>Yes</td>
</tr>
<tr>
<td>4 Minimum drill depth (m)</td>
<td>Not given must drill below upper aquifer and thro main aquifer</td>
<td>30</td>
</tr>
<tr>
<td>5 Maximum drill depth (m)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Average depth in BoQ (m)</td>
<td>45?</td>
<td>35 / 43 variable</td>
</tr>
<tr>
<td>7 Final EOH diameter hard (mm)</td>
<td>171</td>
<td>171</td>
</tr>
<tr>
<td>8 Final EOH diameter soft (mm)</td>
<td>216</td>
<td>Not specified</td>
</tr>
<tr>
<td>9 Final EOH diameter collapsing (mm)</td>
<td>311</td>
<td>Not specified</td>
</tr>
<tr>
<td>10 Minimum acceptable yield (l/s)</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>11 PVC specification</td>
<td>Full</td>
<td>OD 125mm (100ID in BoQ) Class, slot width not specified</td>
</tr>
<tr>
<td>12 Casing / Screen centralisers</td>
<td>Yes</td>
<td>Not specified</td>
</tr>
<tr>
<td>13 Gravel pack</td>
<td>Yes</td>
<td>Yes but sieving not mentioned</td>
</tr>
<tr>
<td>14 Development</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>15 Geophysical wire-line logging</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>16 Yield test</td>
<td>Yes (graphic analysis suggested)</td>
<td>Yes (detailed)</td>
</tr>
<tr>
<td>17 Chemical analysis</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>18 Biological analysis</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>19 Chlorination</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>20 Length of drain (m)</td>
<td>10 (drawing)</td>
<td>10 in BoQ, 7.6m on drawing</td>
</tr>
<tr>
<td>21 Use of reinforcement mesh</td>
<td>Full</td>
<td>Not specified</td>
</tr>
<tr>
<td>22 Construction of soak-away community</td>
<td></td>
<td>Only in BoQ – contractor!</td>
</tr>
<tr>
<td>23 Shortlist of hand pump suppliers</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>24 Hand pump specification</td>
<td>Drawing only</td>
<td>No</td>
</tr>
<tr>
<td>25 Tools and spares</td>
<td>No</td>
<td>Only in BoQ</td>
</tr>
<tr>
<td>26 Report distribution</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>27 Liability period</td>
<td>Yes (5-years)</td>
<td>Yes (1-year)</td>
</tr>
<tr>
<td>28 Terms and Conditions</td>
<td>Yes</td>
<td>Yes (data sheet)</td>
</tr>
</tbody>
</table>
Indeed this review does uncover actual differences in the construction steps and final products between the UNICEF, MoAIWD / District contracts. Some of the differences are significant. These are summarised below:

<table>
<thead>
<tr>
<th>Construction step</th>
<th>UNICEF</th>
<th>MoAIWD</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Average depth of borehole</td>
<td>49.8m</td>
<td>38.5m</td>
<td>41.8m</td>
</tr>
<tr>
<td>2 Average drain length</td>
<td>6.7m</td>
<td>7.1m</td>
<td>6.7m</td>
</tr>
<tr>
<td>3 Use of reinforcing mesh on sites</td>
<td>84%</td>
<td>22%</td>
<td>54%</td>
</tr>
<tr>
<td>4 Development of boreholes</td>
<td>100%</td>
<td>81%</td>
<td>95%</td>
</tr>
<tr>
<td>5 Yield test on boreholes</td>
<td>100%</td>
<td>70%</td>
<td>82%</td>
</tr>
<tr>
<td>6 Chlorination of boreholes</td>
<td>83%</td>
<td>52%</td>
<td>75%</td>
</tr>
<tr>
<td>7 Tools given to WPC</td>
<td>88%</td>
<td>72%</td>
<td>100%</td>
</tr>
<tr>
<td>8 Reporting</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

As shown by the Table in Section 6.3.2 the three contract administrators tend to contract different sets of contractors. The question therefore is: are the observed differences due more to the different performances of the contractors or more to the differences in the contract specification?

Some of the observed differences are significant, e.g. borehole depth (as measured by survey team). The Table above and the Chart below show that the UNICEF average is right on the recommended depth for an AFRIDC installation i.e. allowing for a maximum setting depth plus a sump for silt. The MoAIWD average is a startling 11.3 meters less than UNICEF. The variation could be attributed to contract differences, omission of development procedures on some MoAIWD boreholes, better equipment and technique (i.e. more professional contractors) on the UNICEF contracts or something else.
The Chart below concentrates on boreholes with a discrepancy of 2 or more meters between invoiced depth and actual depth measured during field survey. This was only possible on 75 of the 102 records due to failure to find all the construction reports and invoices. Nevertheless it is clear that the MoAIWD boreholes suffer much more in this respect. The rate of occurrence could be linked to poor or absent development procedure (Item 4 in the Table above) or simply the over-claiming of meters on invoices.

The Chart below attributes yield and water quality problems to the three styles of contracting. It is very difficult to pin-point the exact reason for the observed differences. The three big contractors on the UNICEF contracts experience slightly more problems in this respect but the differences are not sufficiently large to represent any particular trend.

What appears discernible in all of these Charts and statistics is that contractors are less attentive to the recognized procedures on MoAIWD or District contracts than on the UNICEF contracts. This could be due to omission of specification and procedure in the MoAIWD contracts as described. Undoubtedly this has an effect, on depth and lack of reinforcement in the concrete for example but it is concluded that the contracts are less at fault than the actual Contractors.

It is suspected that all of the Contractors are not taking borehole siting seriously enough. Poor siting would tend to a) produce many dry boreholes and b) many low yield boreholes across the board and this is indeed apparent in the data sets.
Significant conclusions are as follows:-

- **MoAIWD contract specifications should be upgraded and aligned with UNICEF specification**

- **Saifro on UNICEF contract is doing a far better job at constructing boreholes than many of the others – as demonstrated by zero occurrence of low yield boreholes and full compliance with developing and yield testing requirements**

- **Most of the other contractors suffer from low-yield boreholes. When UBD and CADCO statistics are combined (same drillers / ownership) then they show a high percentage in this respect. As a high-volume contractor on MoAIWD contracts this is poor. UNICEF high volume contractors Chitsime and HWW are not far behind.**

- **With all four high-volume contractors mentioned above it is suspected that the siting procedures they are using are suspect. All report so many dry boreholes from their various project Lots. Better siting, when eventually practiced, will shine through and reduce the occurrence of low-yield boreholes**

- **Some of the smaller contractors regularly cut corners by reducing borehole depth, omitting reinforcing mesh, development, pump testing, chlorination etc. In some instances this is due to lack of equipment and/or technique in other instances it is just deliberate.**

- **District supervisors are not observing poor practices on site through absence, ignorance or poor ethics. If they were alert and proactive a lesser proportion of low yield boreholes would be observed in the districts. Even the highlighted short-cut contractors would tend to produce better boreholes. This is a serious observation.**
6.4 IDENTIFIED ISSUES WITH CONTRACT DOCUMENTATION

Review Matrix B, (Appendix A1.2) tabulates identified issues (or problems) with contract documentation which can affect hand pump sustainability in the short, medium or longer term. These are presented together with “indicators”, risk and effect and remediation suggestions. In summary the topics are:-

B1  Review contract specification for borehole siting
B2  Review contract specification for borehole drilling
B3  Review contract specification for civil works
B4  Review civil works materials currently provided by the communities
B5  Review contract specification for hand pump supply
B6  Review contract specification for hand pump installation
B7  Review differences in Terms and Conditions differences between the contracting agencies
B8  Review reporting and delivery modalities by the contractors
B9  Review difficulties experienced by the districts in the logistical administration of central contracts

This Matrix does not necessarily cover all issues and indeed there may be other important considerations. Some of the above topics were discussed during the Stakeholder Review Workshop along with the remedial path. These agreed topics are covered in Section 10.
7 REVIEW OF STAKEHOLDER PARTICIPATION

7.1 UNICEF AND MoAIWD

Other than tendering, high level stakeholder participation was not reviewed in detail. It is known that UNICEF are currently funding district water point mapping – which generates an extremely important database showing spatial distribution of hand pumps, functionality, supply gaps etc. Because this mapping does not measure or record hydrogeological parameters it cannot be used to spatially define:

- Groundwater quality – in particular areas of brackish or saline groundwater
- Ground water strike depth and static water level (water table)
- Yield – in particular areas where good yield or dry boreholes can be expected

MoAIWD should be providing technical support to trouble-shoot construction problems encountered in the district when contractors are active, i.e. on site with the Water Monitoring Assistants. It was not possible to capture the regularity of this support. One of the Mchinji WMAs informed that technical assistance was sometimes given.

MoAIWD staff are very active in the siting of boreholes. They seem to do this over the weekends on a private basis with the Contractors - using government-owned resistivity equipment. The method used can be described as “basic” in terms of investigating and finding a sustainable safe site for water. The technique is very poor with, up to a dozen communities sited in one weekend. This siting assistance has been going on from many years – not just on the WASH programme.

7.2 DISTRICT COUNCILS

The district assemblies or councils are key players in the roll-out of the WASH programs. Stakeholder participation was assessed via interview with the members of the District Coordination Team (DCT) as well as analysis of the data from the survey of district water points.

The District Coordination Team has varied membership. Meetings and decision made by the DCT steer much development within the district. In the absence of elected councilors the DCT takes on much of the tasking of the previous District Executive Committee (DEC).

The District Planning and Development Officer (DPDO) is the Chairperson of the DCT and the IPC in all six districts visited. Consequently this person plays a major role in the planning and dispensation of projects giving water to the rural communities.

Other key members of the DCT in relation to water projects are the DWO and DCDO (representing the communities), the DEM (representing water requirements at educational facilities), the DEHO (representing water requirements at health facilities) and more recently (with the inclusion of water points at CBCCCs) the DSWO. The DCT should have a member representing the district NGO input – and these are often also involved in water projects. Other members that can also input to discussion and decisions on water are the DPW, DIO (and/or the M&EO), DFO, DEO and even the local magistrate in one instance (Nkhotakota).
District and DWO participation is reviewed below under several relevant headings:

- Application process – is it fair, demand driven and of even distribution?
- Appropriateness of beneficiaries – are they new communities or schools / CBCCCs previously unserved or are they receiving replacement or duplicated water points?
- Does the community size meet the guidelines (i.e. minimum of 50 households)
- Is the contract being well administered?
- Is the water point database being maintained and updated?

### 7.2.1 Application Process

The Chart below shows that sensitization of the rural communities follows the path expected under the Demand Response approach to rural water supply. The actual person who sensitizes is varied with almost half the communities encouraged by the Extension Workers (WMA, HSA and CDA – 50 counts). Village Headmen and Group Village Headman are also active (27 counts) whilst a small number hear direct from UNICEF staff, Area Mechanics, Members of Parliament etc. The category “Other” is made up of school and CBCCC staff as well as villagers who don’t fit those already mentioned. “Diverted” means that a community is scheduled but the borehole was drilled elsewhere – meaning that the recipients benefited with actually applying. The reason for such diversions was not ascertained.
Several district level stakeholders complained that MPs interfere by:-

- Insisting that boreholes are subdivided according to constituencies. This seems to be founded on fact. The districts do, by all accounts, vet the locations within the constituencies such that they reach the needy and not the politically important. However, it remains that the constituencies are usually allocated equally despite the fact that some were preferentially served in years gone by and may not be in so much need as those that were consistently neglected (Section 7.2.3).

- Trying to receive more water points in their constituencies and particularly for their favourite people. This is not really seen in the above Chart. The occasional community has heard about water project through their local MP but the process of application through the normal channel of community to VDC to ADC to District is clear in all cases.

- Repairing broken down hand pumps using the Constituency Development Fund. This is a bit more problematic because WASH tries to promote ownership and this means that the community contribute toward the spare parts and the AM maintenance service. Thus individuals giving away free parts tend to undermine this concept.

7.2.2 APPROPRIATENESS OF BENEFICIARIES

The Chart below shows how the districts are allocating boreholes. 90% of boreholes and hand pumps are being delivered to new communities. The balance is replacement for old defunct hand pumps.
Whether or not these hand pumps could have been rehabilitated and put back into service is debatable because the circumstances are varied – but some definitely could:

- Old hand pump struck by lightning (1 count)
- Old hand pump - risers dropped down borehole (1 count)
- Old hand pump stolen and borehole abandoned (1 counts)
- Old hand pump stolen and stones dropped inside (2 counts)
- Old borehole/hand pump had a very low yield (2 counts)
- Old hand pump broken down (1 count)
- Old hand pump working (1 count)

Very low yield replacement (foreground)
Yielding abandoned borehole (background)
Mpita School, Mangochi

One of two abandoned boreholes and +/- 10 covered hand dug wells – for 80 households
Mikael village, Mchinji
7.2.3 SIZE OF USER GROUP

The next Chart gives insight on the size of the benefitting community – bearing in mind that the guideline for a new hand pump is 50 households or +/- 250 people.

The WPCs generally gave the number of households using the new hand pump. Experience shows that the figure given can be inaccurate. Thus the chart roughly depicts the difference between small, normal and large User Group using the dividers of 30 and 100 households. It can be seen that Mzimba, Nkhatabay and Blantyre allocate a significant proportion of the water points to small communities of less than 30 households. Many of these were in the range 15-20 households. There was one incident where the water point appeared to be for a single isolated household belonging to the village Headman (Ngoleka Village, Blantyre) – although the representatives found on site said there were 25 households using it.

Conversely some User Groups are very much larger than they should be - 7 exceeded 200 households. The fast-wearing hand pump parts at these communities together with the 21 shared by community and school are likely to wear faster than the average and consequently a greater proportion will be broken down at any point in time in the future. The districts should consider revisiting these areas to evaluate the possibility of construction of additional water points.

7.2.4 DISTRIBUTION OF WATER POINTS

When funding for a batch of boreholes is identified the districts generally distribute them equally between T.A.’s and constituencies - probably as this is seen as the fairest mode of distribution in the eyes of the people – few of whom understand the situation other than in their home village. Indeed this mode of distribution doesn’t ensure that the neediest are served first. The UNICEF method involving a water point coverage map, which highlights the neediest areas, has not yet been fully integrated into district water point management in any of the districts.

Under previous RWS interventions some T.A.’s or constituencies received preferential treatment with repeated borehole allocations whilst others received none at all. The situation arises under the new scheme that although T.A. / constituency distribution appears fair there are still areas within the district which are underserved. Indications of this are apparent in the Chart in the previous section.
Where the hand pump is serving several hundred households the user group should logically be split and more boreholes drilled – aiming at 1 hand pump per 50 households – or as an interim compromise – 1 hand pump per 100 households.

If Mchinji is taken as an example, two very large communities have been served - each by a single WASH hand pump

- Chisasa school and community (390 households)
- Sheko community (200 households)

Both boreholes have good yield but the potential for premature failure is high because of over-use and accelerated wear and tear on the pump - more so at the school because the pedestal rocks in the concrete.

Mikael Village also received a hand pump. The number of households is 80 with compact distribution. Within the boundaries of the same village are two abandoned boreholes. One was once working but was stolen, the other was never installed. There are also at least 10 very neatly constructed hand dug wells (Lilongwe Islamic Movement via the Malawi Relief Fund). All water points described are within a radius of 400m. Clearly Mikael village should have been a rehabilitation candidate and clearly they received a new hand pump at the expense of a more needy community.

It has not been possible to investigate thoroughly whether or not the neediest are being served preferentially other than the odd on-the-road observation such as that just described, but it looks as if many needy areas are being overlooked by the current allocation method of “something” for every T.A or constituency.

7.2.5 GENERAL MANAGEMENT

The processes within District Assembly related to rural water supply implementation are extensive, interlinked and involved. In the period available it was not possible to unravel the components thoroughly particularly as members of the DCT were targeted for interview but many were not available at the time of the visit. Nevertheless many important general observations can and have been incorporated into this review.

The Table below indicates in broadest terms the capacity of each district to manage rural water supply. Many of the indicators are chosen because they show the potential of the present system to competently manage district RWS.
Quality Assurance of Drilling Programmes
SSA/MLWB/2011/00001996-0
Final Report

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>UNICEF GIS mapping key</td>
<td>lost</td>
<td>lost</td>
<td>lost</td>
<td>✔️</td>
<td>✔️</td>
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<td>2</td>
<td>UNICEF GIS mapping software disc</td>
<td>lost</td>
<td>lost</td>
<td>lost</td>
<td>✔️</td>
<td>✔️</td>
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<td>DWO – currently employed</td>
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<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>4</td>
<td>DWO – continuity of office</td>
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<td>3rd</td>
<td>2nd</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>5</td>
<td>DWO has copy of all contract documents</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>6</td>
<td>Paper filing system for community applications</td>
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<td>✔️</td>
<td>X</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>7</td>
<td>Electronic database of community applications</td>
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<td>X</td>
<td>✔️</td>
<td>part</td>
<td>X</td>
</tr>
<tr>
<td>8</td>
<td>Library for borehole reports</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>9</td>
<td>Basic electronic database (e.g. water point mapping)</td>
<td>✔️</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>✔️</td>
</tr>
<tr>
<td>10</td>
<td>Advanced electronic database of borehole parameters</td>
<td>X</td>
<td>X</td>
<td>part</td>
<td>part</td>
<td>X</td>
</tr>
<tr>
<td>11</td>
<td>Final construction reports received from contractors</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>12</td>
<td>Delays in receiving training / supervision budgets</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>13</td>
<td>Supervisory forms provided to / used by WMAs</td>
<td>X</td>
<td>part</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>14</td>
<td>Updating of electronic databases</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>part</td>
<td>part</td>
</tr>
<tr>
<td>15</td>
<td>Administering some contracts direct</td>
<td>✔️</td>
<td>✔️</td>
<td>X</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

The findings can be summarised firstly as observations made by the Consultant and secondly as statements made by the districts:-

Observations by Consultant

- **Staffing.** There is a high turn-over of DWO’s particularly those recruited by UNICEF. This severely affects continuity of data and data management as the old DWO seldom hands over anything to the new DWO and these are effectively “lost” (e.g. data, computer files, GIS key and software).

- **Filing applications.** A paper filing system of community applications is generally present but disorganized. Inputs to these lists vary between applicants (TAs, GVH or individual communities) from very poor to comprehensive. Applications from individual communities need to be filed in order of date such that the “first come – first served” principal is clear to all. Likewise the electronic equivalent is a summarising tool which needs constant up-dating from the paper record. These latter are generally absent – in no small part related to lack the mentioned organised paper filing system.

Some of the districts use VAPs as their “filing system” for community applications. These are good because they have been organised under a project and are comprehensive in terms of coverage. However they are not easily up-dated if they are old which many of them are.

- **Borehole supervisory records.** The “paper trail” from site supervisor to DWO appears very poor. Some district WMAs keep notebooks and then transfer to multiple borehole summary forms provided by MoAIWD / DWO whilst others do not. These records may or may not be presented to the DWO for filing. None of the DWOs file per-borehole a set of specific supervisor forms for all 6 stages of construction\(^\text{13}\). Indeed, many of the district DWOs report that when an invoice arrives a senior team is assembled to go around the sites to see if they are complete and working. If the WMA supervision process and reporting process were efficient then there would be no need for this circuit as office records could be consulted. Only problematic hand pumps (again documented) would need to be re-checked – such that Contractor could be instructed to remediate before payment is made.

\(^{13}\) 6 stages of supervision: siting, drilling, development, yield testing, civil works and installation
• **Library.** Districts are not receiving the final complete construction reports from MoAIWD, UNICEF or Contractor. Some incomplete versions reach the DWOs desk during invoicing but these are usually removed by Contractor. Consequently there is no “library” of project reports (with all the raw data). Also in consequence there is no electronic library or database which summarises key hydrogeological data so essential for district RWS management.

• **Update of maps.** Some of the districts have electronic water point mapping data as generated by UNICEF programs but these lack essential hydrogeological parameters – which come from very same construction reports and also through community feedback / monitoring. Some of the districts have excellent water distribution atlases produced by UNICEF – these being produced from the water point mapping data. There is no sign at all that these are being updated. Indeed 4 of the 6 districts have misplaced or lost the ARC GIS key and software. Mangochi district had also misplaced theirs but have temporarily borrowed a replacement from another district. The maps and databases are time bound snapshots and become out of date and misleading if not updated at least monthly or during active projects. This is not being done.

• **Office and equipment.** Only Mzimba had a decent RWS management office (built by AfDB project). Elsewhere DWOs office is usually cramped with only a table and a computer. These offices are lacking filing cabinets and shelving in particular. All have single computer but lack of virus protection and a regular back-up procedure is a constant threat to RWS management.

• **Supervisory equipment.** The DWO has no budget to provide WMAs with basic safety and supervisory equipment.

**Issues Raised by Districts**

• **Funds.** The monthly funds received from MoAIWD for all district activity related to RWS is <120,000 MWK. This is barely sufficient to run the office and cannot cover activity of WMAs. All districts maintain that funding for supervision and training from UNICEF is not quarterly but erratic (usually annual) and usually arrives late for activities applied for – particularly for pre-training

• **Contract documents.** Districts maintain that they are not circulated the full set of contract documents particularly the technical specifications, drawings etc. There are differences between the direct UNICEF and the MoAIWD contracts specifications – so their remonstrations appear valid

• **Efficiency of district management.** Districts maintain that when the contract is “central” (MoAIWD or UNICEF) and comprising multiple district “Lots” then supervision and management becomes problematic:–
  
  o Contractors move to other districts before completion – disrupting schedules and logistics
  o Contractors answer to central command and not to the district causing conflicts and delays

• **Manpower shortages.** With the exception of Lilongwe District – all the districts maintain that they have highly inadequate man-power and associated equipment in terms of WMAs to supervise project drilling. Mzimba district is intermediate in this respect as many of the WMAs trained under the AfDB-project are still present although their equipment is now dilapidated.

• **Management of Extension Workers.** Several districts touched on the capacity, behaviour and management of Extension Workers. These individuals are community-based and often have other areas of income – otherwise known as “side-businesses”. Due to this their attention to supervisory processes can be second in their personal priority list. In addition some of them see borehole construction as an opportunity for additional business. Many of the WMAs are technically wanting
in terms of supervisory capacity and need training or re-training. Lastly some Extension Workers don't look after themselves and are disorderly at the construction site. This probably relates to a minority but is a problem affecting the rural sector where control and supervision is lacking.

7.3 EXTENSION WORKERS (AND AREA MECHANICS)

There are three categories of Extension Worker in Government service and their numbers were captured during survey in the Table below. It is clear that HSAs significantly out-number WMAs and CDAs. Each HAS is responsible for a small cluster of villages and can therefore interface with each enclosed community on a fairly regular basis. The reporting systems of MoH are such that monitoring data on water source, functionality, cleanliness as well as sanitation and hygiene topics is captured and tabulated at regular intervals.

<table>
<thead>
<tr>
<th>District</th>
<th>WMAs</th>
<th>CDAs</th>
<th>HSAs</th>
<th>AMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lilongwe</td>
<td>24*</td>
<td>28</td>
<td>1112</td>
<td>89</td>
</tr>
<tr>
<td>Mchinji</td>
<td>2</td>
<td>9</td>
<td>346</td>
<td>19</td>
</tr>
<tr>
<td>Mzimba</td>
<td>7</td>
<td>15</td>
<td>600</td>
<td>73</td>
</tr>
<tr>
<td>Nkhatabay</td>
<td>4</td>
<td>10</td>
<td>180</td>
<td>46</td>
</tr>
<tr>
<td>Blantyre</td>
<td>3</td>
<td>14</td>
<td>630</td>
<td>55</td>
</tr>
<tr>
<td>Mangochi</td>
<td>4</td>
<td>16</td>
<td>560</td>
<td>52</td>
</tr>
</tbody>
</table>

* Before the recent AfDB intervention there were only 3 WMAs.

WMAs and CDAs, on the other hand, have much larger districts to manage – usually entire T.A.’s. As they have to be in the communities during the construction and training steps associated with the WASH Programme mobility is essential. Most have access to motorcycles but distances are large and fuel budgets are seldom sufficient or available on time to do the work comprehensively.

7.3.1 SUPERVISION BY EXTENSION WORKER.

The six steps of borehole construction that need supervision are:-

- Siting (geophysical checking of 3 community selected sites)
- Drilling including placement of casing, screen and gravel pack
- Development (cleaning until water is sediment free)
- Yield testing and water sampling (ensuring water is sustainable and potable)
- Civil works construction (to design with materials, quantities and procedures per contract)
- Installation (ensuring setting depth, joints and timing are optimized).

Under current policy this supervision is provided by the districts using extension workers under the guidance of the District Water Officer. The survey has ascertained that the supervisor is almost always a Water Monitoring Assistant, occasionally a Borehole Maintenance Officer.

The Chart below shows that the average presence of supervisor on site during the 6 described stages – as reported by the WPCs - hovers around 50% for Mchinji, Mzimba and Nkhatabay districts and drops off in the order Blantyre, Lilongwe to Mangochi which shows that less than 1 of the 6 critical construction components were done in the presence of a supervisor. Mangochi reports that this is due to donor funding for supervision always arriving late or not at all. The other districts
also report this problem to varying degrees. That Blantyre and Lilongwe supervision is below the overall average is surprising but could be related to more frequent alternative (paid) events that lure the supervisors away from the sites.

![Average presence of Supervisor (WMA) during 6 construction steps (WPC report)](chart)

Obviously this only provides insight on supervisor presence – not quality of supervision i.e. how interactive was the supervisor and how well did he/she keep the records. The survey was not able to go to this level of checking but the Chart below (Chart in Section 5.2 reprocessed per district) shows correlation in that more problems with water yield and quality are seen in Mangochi and Blantyre districts – where supervision was poorest. This can hardly be coincidental but it is also seen that all the districts suffer a common problem: poor attendance and poor quality of supervision.

![District analysis of WPC reports of low yield and poor water quality](chart)

Indeed all six districts show definite room for improvements to the supervisory process. Above all else – how are 21 boreholes / hand pumps approved that have constructional or water quality flaws?

The Table below demonstrates that the Contractor has failed to do a complete and professional job at many sites – this because district supervision has been generally poor. The WPCs are the reporters. That they watch the processes is demonstrated by the question on gravel pack – all confirm that gravel was inserted (note that this does not convey how much and of what type). When it comes to development, yield test, reinforcement mesh, chlorination and hand over of tools and spares by the contractor – the positive responses drop and the negative responses rise.
<table>
<thead>
<tr>
<th>Question posed to WPC</th>
<th>Done</th>
<th>Not done</th>
<th>Don't know</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Gravel placed?</td>
<td>102</td>
<td>0</td>
<td>0</td>
<td>102</td>
</tr>
<tr>
<td>2 Development done?</td>
<td>94</td>
<td>7</td>
<td>1</td>
<td>102</td>
</tr>
<tr>
<td>3 Yield test done?</td>
<td>87</td>
<td>14</td>
<td>1</td>
<td>102</td>
</tr>
<tr>
<td>4 Reinforcing mesh placed?</td>
<td>54</td>
<td>45</td>
<td>3</td>
<td>102</td>
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<td>5 Chlorination done?</td>
<td>65</td>
<td>25</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>6 Tools given?</td>
<td>90</td>
<td>12</td>
<td>0</td>
<td>102</td>
</tr>
<tr>
<td>7 Spares pack given?</td>
<td>59</td>
<td>39</td>
<td>4</td>
<td>102</td>
</tr>
</tbody>
</table>

The following two Charts show that many communities did not receive their spares pack (fast wearing parts that are the kick-start to long term community O&M) nor the fishing tool. The latter is part of a tool kit comprising at least two types of spanner and the fishing tool. With some of those not given a fishing tool the reason may be that the cylinder contains the Rev 4 variant – a threaded brass plunger – which is used to do the fishing. Having stated this some communities with the standard Rev 3 footvalve with an eye did not receive the fishing tool from the contractor – which is a serious abnormality.
The items “not done” in the above table are really quite unacceptable as many of them impact on water point sustainability. The Contractors should not be failing in this respect. But the site supervisors, the WMAs, and indirectly their management (district and ministry) shoulder much of the responsibility for these omissions.

### 7.3.2 Monitoring by Extension Workers

Regular water point monitoring is essential because the WPCs respond to regular / formalised visits from Extension Workers and, in consequence, long-term water point practice and sustainability improves. For example the Extension Worker does a simple leakage test on the hand pump and recommends that the seals are replaced by the time of next visit or criticises the style of waste water management and calls for improvement. During the subsequent monitoring visit the requested improvements are checked. When this sort of proactive monitoring is in place then the WPCs tend to be interested, involved and responsive.

The districts are in the essential position to carry out water point monitoring. All three classes of Extension Worker and, in addition, the Area Mechanics and indeed the WPC Care Takers should take on active monitoring roles. Monitoring does not require substantial budget lines – it simply has to be coordinated, formalised and mainstreamed into day-to-day village administration by local stakeholders.

From this survey it has been ascertained that only the HSAs have compiled monitoring records. There is therefore room for significant improvement in monitoring procedures. This would start with the identification and listing of crucial monitoring indicators relevant to hand pump sustainability, health and hygiene practice etc., followed by the design of simple monitoring forms to be checked by the monitor during each visit.
7.4 **Beneficiaries (The Users of the Water Points)**

The survey generated a lot of responses from the beneficiaries, both WPC and general community members. These responses can be analysed in so many different ways and styles to reflect on water point quality and sustainability, contractor competence and delivery, district management (Council and Extension Workers) and indeed on their own level of competence, knowledge and management capacity. This latter facet, community stakeholder participation, is analysed under a number of sub-sections presented below.

7.4.1 **Trainings Received**

Only 1 of the 102 sites visited did not have a WPC. A few others had some problems with insufficient membership or the ridiculous situation where the community believes that the WPC has an elected term of office at the end of which all members are replaced by totally new members with no training or experience. Members can be occasionally replaced due to non-performance but not the entire WPC all at once. This concept is very harmful to water point sustainability and should be eradicated.

However, the overriding impression is that the vast majority of community applicants receive pre-training sufficient for the formation of the WPC.

CBM training is divided into two components according to the national CBM manual (MoAIWD, 1999). Pre-training is a 1 or 2 day event and covers, WPC formation and composition, preparation for borehole siting construction and provision of civil works materials. Post-training is a 5-day event carried out jointly by all 3 Extension Worker categories and covers an extensive list off topics.

The Chart below shows excellent average WPC membership in terms of numbers and gender – which demonstrates good uptake of the training fundamentals.

![Chart](image)

The two Charts below indicate the proportion of WPCs receiving pre and post-training. Although the depth and completeness of topic coverage is not illustrated it can be seen that most of the 102 sample sites had received both sets of training. Those not receiving post-training are reported by the districts to be on the list to be trained once funds for such are available.
7.4.2 Operation and Maintenance – Contribution of Funds

The establishment of an O&M fund and/or a collection of spare parts are recognised as very important part of overall hand pump sustainability as it empowers a community to maintain and self-repair their hand pump when it breaks down. In fact under WASH, some districts insist that groups applying for a hand pump must prove their O&M ability by bringing a deposit slip or statement proving the opening of a savings account. This was seen in Lilongwe District and could be that some of the communities satisfying AfDB project criteria and being accepted for drilling under WASH (not known for sure).

The two charts below indicate that the vast majority of WPCs do have a fund for O&M. However the level of saving is generally very low in all districts. As might be expected by being proximal to major cities Lilongwe and Blantyre rural communities have relatively higher WPC fund average than the rest with the exception of Mzimba District. This latter district has been sensitized in a recent (AfDB) project and this may have a bearing on the higher value of the WPC funds.
What seems to be lacking is the absence of regular saving. Most of the WPC quoted funds may be the initial deposits cited above with no inflow thereafter. Better O&M funds could be achieved by a regular or annual contribution per household. The exact contribution could be advised to the WPC during training. A small minority of well organised WPCs are indeed already practicing this as evidenced by written records of households, date and contribution.

14 In Zambia O&M contribution for "preventive maintenance" as well as repair has been achieved under some interventions at about ZMK2,500 (MWK150) per month per household. Payment can be deferred until after the harvest seasons when financial resources are available.
7.4.3 **OPERATION AND MAINTENANCE – WATER POINT MAINTENANCE**

The Chart presented below shows per district the extent to which the WPCs can fish the footvalve – a corner pin requirement of VLOM. The analysis is encouraging in that most WPCs can fish the footvalve and require little encouragement and advice to do so. Lilongwe District is low for unknown reasons. Mangochi District is low probably due to inadequate training.

Where the cylinder arrangement was not the standard plastic plunger, plastic footvalve with fishing-eye and one of the less frequent variants (Section 5.7.2) then WPCs have problems with the fishing procedure. Many of these WPCs could not fish the threaded type of footvalve. This is potentially a very serious area of concern as it takes O&M away from the WPC to a higher level (AM or District). The AFRIDEV is a VLOM pump – the mentioned variant is less VLOM than the standard Revision 3 and WILL impact on hand pump sustainability.

![Chart showing footvalve fishing by district]

Other visible signs that the WPC has been active in VLOM, both negative and positive, include the following:

- **Riser damage.** At 2 sites the rising main revealed signs that the community had removed it – which is an advanced O&M topic. In both instances it had not been removed by the safe “Mphanda” system but by the bad system of heating the riser joints as they are lifted out to break the glue bond and to slightly expand and separate them. This is very bad practice because firstly the hand pump when re-assembled leaks through these loose joints and secondly the potential for permanent breakdown and abandonment is greatly increased.

- **Brick aprons.** Responding to training, many WPC had placed a protective ring of burnt bricks around the pump slab and drains. However, these were seldom repaired when feet dislodged them – leaving many water points untidy and hazardous to navigate.

- **Basin closure.** At a number of water points the WPC had closed off the basins on the wash stand – this obviously after group discussion and agreement – which is a positive response if not a somewhat odd decision.
• **Informal repairs.** A number of these were witnessed, the most obvious of which was the use of a branch to replace a worn out handle pivot pin and bush. This actually points to a poor quality, loose handle sleeve as well as pivot pin - as covered in Section, 3.7.3.

The survey team subjected each hand pump to a leakage test – how man strokes necessary to fill a 20 liter bucket. This gives an impression of overall condition of the pump seals:

- Less than 50 strokes – seals fine
- 50-70 strokes – seals worn
- More than 70 strokes – seals very worn – needs urgent O&M

The Chart below gives the results of this test. It can be seen that 29% of the pumps are in good condition (blue bar), 57% show signs of worn seals (pink bar) whilst 14% (red bar) are in urgent need of O&M - to replace the seals.

It is when the seals are worn and the leakage test gives 50-70 strokes that the WPC should understand that their pump is inefficient and needs “preventive maintenance” That 14% are on the verge of yield failure is alarming because it suggests that a) the WPC do not recognize the condition b) are not motivated and/or c) preventive maintenance is not practiced. Two hand pumps were...
broken down with this problem during survey. Indeed the survey team with the WPCs replaced at least 10 sets of seals during the field circuit. It seems that some hand pumps will be broken down for prolonged periods due to simple O&M problems such as this. Perhaps the advent of Area Mechanics to the districts will improve this situation and allow preventive maintenance to be practiced rather than only breakdown repair.

7.4.4 CONSTRUCTION OF SOAK-AWAY

Under WASH the communities contribute to the construction process in a number of ways – one of which is the construction of a soak-away to eliminate ponding of dirty water and any health hazard that could be associated. As can be seen from the Chart below the majority of sites checked have no waste water management in place (62%) whilst a mere hole had been excavated at 17% of the sites – many of these were full of putrid water. At the remaining 22 sites (21%) the soak-away was complete in that the hole had been infilled with rocks and sometimes a cover fitted. Within this “complete” category are a number constructed by contractors in Mangochi District (photos). Failure to manage waste water is pointing to:-

a) Poor training (and monitoring) by Extension Workers and
b) Poor motivation by communities.

It was also noted that attempts to manage waste water in highland districts of Lilongwe and Mchinji is often thwarted by fine soil type which prevents infiltration even when a pit is dug. Photos 5 and 6 below show some alternative methods of waste water management from other projects and areas.
Soak-away 1
No soak-away at all
Uhoho Sch, Nkhotakhozi District

Soak-away 2
Constructed soak-away with lid
Likungwi, Mchinji District

Soak-away 3
Simple pit soak-away
Chisasa Sch, Mchinji District

Soak-away 4
Contractor-constructed soak-away with lid
Makunganya, Mangochi District

Soak-away 5
Banana garden – where soils are fine
Not WASH borehole, Mangochi District

Soak-away 6
Vegetable garden – where soils fertile
Not WASH borehole, NW Zambia
### 7.4.5 WPCs Supervisory Capacity

At present it is recognised that there is need for independent technical supervisory capacity – either by consultants or district Extension Workers. This short section reviews the capacity of the actual beneficiaries via the WPC to supervise the construction of their water point.

The WPCs capacity to supervise the 6 steps of borehole construction depends to massive extent on the literacy and ability to observe, measure and record in a notebook. Thus the Chairman and Secretary positions are very important.

From the survey it can definitely be concluded that the WPC and community are capable of reporting observations but very poor at reporting process detail and measurements – which are essential for durable and sustainable water points. An example of the former has already been presented in the second Table in Section 6.3 where the WPCs were able to communicate whether or not gravel, development, yield testing and chlorination had been done (or not). Conversely, they could not give the detail, e.g. what type of geophysical machine was used or was the gravel installed clean or was the grade of PVC casing or riser to specification.

An example illustrating that WPCs are not good at reporting measurement and details is presented in the Chart below. Only a few of the WPCs could inform the number of PVC casing pipes installed in the borehole. Of the 13 that responded only 7 were correct – these were all at sites where the WPC had the competence to record everything in a note book.

![Chart](chart.png)

The obvious conclusion here is that the odd WPC is sufficiently aware and educated to record construction detail but the vast majority of WPCs currently are not. This is not likely to change in the foreseeable future. In short construction supervision and reporting must come from an external, appropriately trained agent.
7.5 IDENTIFIED ISSUES AT DISTRICT LEVEL

Review Matrix C, D and E (Appendix A1.3, 1.4 and 1.5) tabulate identified issues (or problems) with district management of water supply, supervision of water point construction and WPC performance which can affect hand pump sustainability in the short, medium or longer term. These are presented together with "indicators", risk and effect and remediation suggestions. These Matrices do not necessarily cover all issues and indeed there may be other important considerations. Some of the above topics were discussed during the Stakeholder Review Workshop along with the remedial path. These agreed topics are covered in Section 10.

The issues are listed separately under District, Supervision and WPC sub-sections below.

7.5.1 DISTRICT MANAGEMENT ISSUES

C1 Review employment continuity of DWO
C2 Review management of WMAs
C3 Maintaining up-to-date water point register and allocation list
C4 Review knowledge of DWOs
C5 Review water point allocation process
C6 DWO equipment and DWO office equipment
C7 Management of central contracts
C8 Back-stopping (by MoAIWD or appointed consultant)

7.5.2 SUPERVISION ISSUES

D1 Insufficient number of WMAs
D2 Lack of knowledge of WMAs
D3 Corrupt practices
D4 Lack of transport budgets for WMAs
D5 Inadequate or no site records
D6 No WMA records being filed by DWO
D7 WMA equipment
D8 WMA safety-wear
D9 Back-stopping

7.5.3 WPCs ISSUES

E1 Need to provide "areas" rather than "points" to siting teams
E2 Not prepared for the arrival of drilling rig
E3 Not observant during drilling procedures
E4 Not making measurements during drilling procedures
E5 Not providing civil works materials on time
E6 Not keeping hand pump surroundings clean and tidy
E7 Not repairing hand pump when worn or broken down
E8 Poor maintenance procedures
E9 Poor waste water management
E10 Not able to complain to contractor due to lack of knowledge
8 SUMMARY ON WATER POINT SUSTAINABILITY

8.1 GENERAL

Various percentages have been generated on a randomly selected sample of 102 boreholes and hand pumps completed over the last 5-years. Although the sample size could be bigger the percentages are regarded as statistically robust and representative of the 2,000+ water points that have been funded by UNICEF. Considering everything presented in the preceding sections the main deductions are:-

On hand pump functionality (sample size 102):-

- 93% are functioning and used for all domestic water
- 3% are permanently out-of-action (beyond repair)
- 4% are working but not used for drinking water (poor quality)

The 3% out-of-action boreholes are all due to excessive siltation and blocking of the pump cylinder. This is underpinned by a) difficult local hydrogeology (saturated and highly collapsing ground) and b) very narrow drilling diameter coupled with the wrong drilling technique. Data suggests that a further 5% of the functional boreholes also have a latent siltation problem that will cause the borehole / hand pump to fail prematurely in the future.

On community satisfaction (sample size 100):-

- 76% are satisfied with yield and quality
- 12% are not satisfied with yield (these are all low to very low yield boreholes)
- 7% do not use for drinking water (salt and/or iron above WHO guidelines)
- 5% more are not satisfied with quality (salt and/or iron nearing WHO guidelines)

The low yield occurrence is frequently related to shallow drilling depth. Indeed 78% of the low yield boreholes are less than 45m deep and 50% are less than 40m deep. Shallow depth is often caused by the contractors’ inability (or reluctance) to go deeper and fully penetrate the aquifer. This in turn can be related to very narrow drilling diameter coupled with poor drilling technique in very loose and saturated formations.

Not only depth but poor site selection (geophysics) contributes to the occurrence of low yield boreholes. Of the 2,000 UNICEF-funded boreholes it is calculated that an additional 27.5% (or 550) have been abandoned dry or with very low yield. Two contributing factors are indicated, a) contractor reluctance to up-grade geophysical survey and b) tendency of WPCs to provide preferred spots as defined “points” rather than general “areas”. Low-yield outcome is accentuated in areas of difficult hydrogeology.

These measurable factors are only the “tip of the iceberg”. There are additional potential problems hidden down sampled boreholes that are currently functional and used. There are also potential user O&M irregularities to consider. Thus, as the years pass it will be a percentage of these boreholes and hand pumps that tend to breakdown more frequently with some being abandoned completely – because the users are either unable or unmotivated to repair. This type of problem could be related to one or more of the following in approximate order of severity (not an exhaustive list). The percentages are estimated based on the field observations during survey:-
• Premature wear caused by abnormal use (>100 households), up to 15%
• Pump neglect by non-motivated WPCs, up to 10%
• Excessive siltation up an around the pump barrel (exacerbated in shallow boreholes), 2-5%
• Poorly quality hook and eyes on the rods - snapping off and failing to be fished, up to 3%
• Rocking pedestals causing rapid wear of down-hole components, up to 2%
• Bent bores and off-vertical pedestals causing premature rod/riser wear and failure, up to 2%
• Incomplete fitting of riser pipes / sockets or cut risers with waisted double sockets, up to 2%
• AMs or bush-mechanics who join dislocated risers by heating, burning and warping ends, up to 2%
• Damaged cylinder components caused by poor timing and inability to “fish” up to 1%
• Non-availability of spares to match four different cylinder arrangements (indeterminate %)
• Dropping of pumps parts by careless WPCs and/or AMs (indeterminate %)
• Theft of pumps and rods / riser (indeterminate %)
• etc.

The current review is carried out on water points that average 2 years and do not exceed 5-years in age. All of the above indicate that hand pump functionality is heading for the 80% or even 70% mark by the end of 5-10 years of constant usage by ever-expanding user communities

All the above issues can be reduced with attention to several crucial areas

1. Ensuring that professional, well-equipped contractors are appointed and that the right techniques are employed throughout all 6 construction steps (siting through to installation)

2. The current subtly differing contract styles are edited and aligned. The current MoAIWD contract has general omissions and lack of technical specification detail – which, in effect, allow the contractors to practice poor techniques

3. Ensuring that the pool of district supervisors (WMAs) is increased and better trained. The current poor level of supervisor knowledge and technique allows the contractors to practice poorly and this leads to poor quality products. Poor supervisor reporting skills and poor ethics are also instrumental and both need attention.

There are many other issues that do not really pose a threat to hand pump sustainability but are nevertheless important. These include:-

• Avoidance of pollution sources and other hazards during siting
• Quality, dimension and durability of civil works
• Waste water management by users – soak-away, garden, cleaning etc.
• Poor quality of civil works materials supplied by communities
• etc.

In final summary all the above highlighted points are very real and will not reduce unless the following are addressed:-

• Contracts are uniform and the technical specifications cover all construction topics and steps
• Contractors adhere to the technical specifications without deviation or omission
• Contractors are supervised properly by supervisors during all 6 construction steps. Essential.
• The supervisors are well trained, proactive, honest and motivated
• The supervisory process is well documented and stored (by the districts)
• The DWOs, WPCs and AMs are trained and alert to both good and bad hand pump O&M practice
8.2 SPECIFIC

During the survey of the 102 water points and interview of the corresponding WPCs the two survey leaders summarised and ranked each water point WPC according to a ranking scheme ranging from excellent through to bad. The survey leaders are both highly experienced in their respective fields, water point construction and CBM training. Thus their overall ranking, encapsulated in the two Charts below, shows in summary form - all that has been expressed above in relation to construction, site choice, training and management. The ranking schemes used by each surveyor are given in Annex A3.

Put another way, Sections 4 through 7 are the presentation and interpretation of analyses of data by the overall Team Leader, Mr. Anscombe whereas the above two charts are individual views of two experienced Malawi water-sector representatives.
9 STAKEHOLDER REVIEW WORKSHOP

The main questions that are posed by the review as presented are:-

Are the irregularities in process and technique - as identified - acceptable?

Can UNICEF, MoAIWD, districts and end-users accept the current functionality percentage and the projected percentage after a further decade of deterioration?

Can anything be done to improve longer-term sustainability?

To address these, UNICEF organised a Stakeholder Review Workshop at Lilongwe Hotel on 30th November 2011. This was attended by key stakeholders from the MoAIWD, NWDP, UNICEF, Contractors and by representatives from the District Assemblies for the 6 districts included in the survey.

The answer from these stakeholders to the last question above is that there are many areas where the borehole / hand pump delivery processes can and have to be improved.

The Review Workshop took the form of a presentation by Mr. Anscombe, Managing Director of the review consultant (Rural Water Supply Ltd) and author of this report. This presentation was broken down into an Introduction and three review components:-

• Introduction to the five components of the hand pump sustainability chain
• Construction and Contractors
• Tendering and Contracts
• District Participation including:-
  o District management
  o Site supervision
  o WPCs

Following each presentation a plenary session was held in which the stakeholders asked for clarification, input additional information and began the process of formulating recommendations.

The workshop concluded with the stakeholders proposing, discussing and agreeing key recommendations together with those responsible for turning such recommendation to action.

Time constraints foreshortened the discussion of all issues raised by the review workshop. Main resolutions are presented in Section 10. These same points (and the others) are itemized in the various sections above and in the annexed Review Matrices (Annex A1.1 to A1.5).

The mentioned presentations are not annexed to this report – as most of the slides and photos are in the preceding sections. However the slides showing the five components of the hand pump sustainability chain are shown in Annex 6.
### 10 WAY FORWARD

The table below itemizes the main resolutions of the Stakeholders Review Workshop.

<table>
<thead>
<tr>
<th>No</th>
<th>Action</th>
<th>Due Date</th>
<th>Responsible</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Contract Standardisation:</strong> The Technical Specifications, Bill of Quantities and Terms &amp; Conditions need to be extensively re-viewed, improved (to eliminate any loopholes) and unified. Particular emphasis on siting, drilling depth and drilling method - as this has impact in terms of low yield or shallow/silt-rich boreholes.</td>
<td>June 2012</td>
<td>MoAIWD supported by UNICEF</td>
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<td>2.</td>
<td><strong>Pre-qualify Contractors:</strong> Pre-qualification of contractors to eliminate those with bad track-record and/or inadequate drilling and siting equipment. Meet with ODPP to present the problem areas encountered and why pre-qualification is essential.</td>
<td>June 2012</td>
<td>MoAIWD</td>
</tr>
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<td>3.</td>
<td><strong>Siting:</strong> Detailed siting procedure specified for difficult areas to improve success rate and reduce number of low-yield boreholes. Difficult dry areas to be clearly identified and flat rate per type of site included in the contract to maintain appropriate expertise</td>
<td>Mar 2012</td>
<td>DWR, MoAIWD</td>
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<td></td>
<td></td>
<td>Sept 2012</td>
<td>DWR, MoAIWD</td>
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<td>4.</td>
<td><strong>Decentralise procurement and management of contracts:</strong> Wherever possible, districts to procure services and manage the contracts Role of central ministries to monitor and support (e.g. improve and standardise contracts, pre-qualify contractors, quality assurance, etc)</td>
<td>2012 onwards</td>
<td>MoAIWD, Districts</td>
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<td>5.</td>
<td><strong>Supervision:</strong> WMAs, DWO’s, (also AMs and CDAs) to be trained in supervisory techniques for all 6 construction steps (siting, drilling, development, yield testing, civil works and installation) as well as reporting procedures / formats and the understanding of the contract specifications. Increase the number of WMAs to at least one per T.A.</td>
<td>2012 - 2013</td>
<td>MoAIWD UNICEF &amp; NGOs MoAIWD</td>
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<td>6.</td>
<td><strong>Review Community Based Management Manual:</strong> Roles of Water Point Committees (WPC)/Caretakers and Area Mechanics (AM) to be reviewed particularly regarding the type of repairs they should be responsible for. Trainings for WPCs and AMs to be revised accordingly.</td>
<td>June 2012</td>
<td>MoAIWD with UNICEF support</td>
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7. **Revise Community Contributions:**

   Communities should provide fixed cash contributions to rather than "in-kind" (as quality control of materials is critical)

   | 2012 onwards | MoAIWD |

8. **Borehole Stakeholder Association:**

   An association of boreholes stakeholders (e.g. contractors, districts, central ministry, NGOs etc.) to be established to promote further dialogue in order to improve performance in delivering rural water supply.

   | June 2012 | MoAIWD Contractors Districts NGOs |

11 **REFERENCES**


