



Partners for Water and Sanitation

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Partners for Water and Sanitation

**Support to Addis Ababa Water and Sewerage Authority,
Ethiopia**

Sewer Network Design Training

Submitted by:

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August 2009

Contents amendment record

This report has been issued and amended as follows:			
Revision	Description	Date	Signed
0	First draft for review	Jul 09	AS
1	Final draft for presentation	Aug 09	AS

Support to Addis Ababa Water and Sewerage Authority, Ethiopia

Report on Sewer Network Design Training

1. Background

The Addis Ababa Water and Sewerage Authority (AAWSA) is responsible for the collection, treatment and supply of potable water and the collection, treatment and disposal of waste water for the City. AASWA is accountable to a board of directors who in turn are accountable to the Mayor of Addis Ababa.

AASWA and Partners for Water and Sanitation have been working on a partnership aiming at needs based capacity building for the operation, management and further development of the AAWSA waste water infrastructure. To achieve these aims, AAWSA and Partners for Water and Sanitation set the following objectives for their cooperation:

'The aim of the support to AAWSA is to identify capacity gaps and help to build capacity in areas of sewer system management, operation and maintenance, together with a transfer of appropriate skills in waste water treatment and disposal.

It also aims to provide technical and managerial support that will enable AAWSA to establish a sustainable financing strategy, in order to support a technically, financially and economically viable institution.'

Resulting from the objectives, anticipated key deliverables from Partners for Water and Sanitation to AAWSA included:

- 1. A report on identified capacity building needs, based on the initial assessment visit, discussions and workshop;*
- 2. Identified and agreed methods to address these needs, through a range of support packages – such as technical assistance and training;*
- 3. Developing & delivering support packages for effective & efficient, sewerage service delivery based on needs-assessment, which also includes providing support to AAWSA in designing a sustainable financing strategy and addressing technical and managerial capacity gaps ;*
- 4. Follow-up support through inputs to delivering capacity building, monitoring and evaluation of learning and the level of implementation of the knowledge gained.*

In August 2008, based on the objectives and deliverables, AAWSA and Partners for Water and Sanitation undertook a needs assessment. The resulting report was completed and agreed in December 2008. The two parties agreed that the immediate priorities for cooperation were the potential re-use of waste water treatment works effluent and training in sewer network design.

In March 2009, Partners for Water and Sanitation sent a UK expert to AAWSA with the objective of having a preliminary investigation on the potential re-use of waste water treatment works effluent.

In May 2009, Partners for Water and Sanitation sent a UK specialist on the design of sewer networks to AAWSA. The objective was to provide six days training on the design of sewer networks to AAWSA engineers and operational staff. The visit was preceded by several weeks of discussions between AAWSA and Partners for Water and Sanitation on the appropriate training contents, course length and mode of delivery. The course was delivered by Adolf Spitzer from Mouchel.

2. The Training

2.1 Mode of Delivery

The training course had a duration of six days and was held from Monday 25 May 2009 to Saturday 30 May 2009. The training was delivered by Adolf Spitzer of Mouchel, Scotland Water branch.

The training was classroom based and all sessions from Monday to Friday convened in the afternoon from 13:00 h to 17:00 h. The Saturday session was held in the morning from 09:00 h to 13:00 h.

Visual aids for course delivery were PowerPoint presentations and flip charts. General delivery of the training was through a series of lectures. However, it was always tried to keep the training as inter active and relevant to AAWSA's particular circumstances as possible. This was achieved through several group work exercises and presentations, as well as discussions of subject matters amongst course participants wherever possible. It was further enhanced by incorporating issues that were of direct relevance to the AAWSA at the time of training. For this, AAWSA staff showed Adolf Spitzer around four sites they were working on and the issues associated with each site were incorporated into the training course.

2.2 Training Participants

Nineteen AAWSA staff members participated in the training and all of them were involved in running Addis Ababa's sewerage services at the time. The group consisted of engineers and operational staff. In addition, the head of the sewerage services department, Ato Zereu Girmay, participated in the training whenever his schedule allowed. Appendix 3 shows names and contact details of the training participants.

2.3 Training Contents and Materials

Training included the topics of sewer network design, pumping station design, an introduction to combined sewer overflows, survey work and data documentation, and an introduction to sewer network modelling principles (see Appendix 1 and 2 for details).

Training contents were a mixture of general sewer network design principles, detailed design guidance based on UK standards and experiences, and issues that were of significant relevance to the AAWSA at the time.

To address the issues of immediate relevance to the AAWSA, four sites with ongoing or planned work were visited. The issues included first time connection of a mature residential area, first time sewerage of a mature residential area and leaving sufficient capacity for a yet to develop greenfield site further upstream, laying of sewers next to rivers and in potential flood planes, a pipe bridge, and the rehabilitation of a trunk sewer that was cut during excavation work for a multi storey building. Issues with building micro pumping stations for lifting sewage from low lying localities into the gravity network were also discussed.

The AAWSA was provided with core literature a week prior to the start of the training. Handouts showing the presentations of the day were provided during the training period. At the end of the training, each of the participants received a CD containing all presentations provided, manuals, tables and calculation tools for the design of sewer systems, as well as literature on environmentally friendly surface drainage systems. In addition, the contact details of the training instructor were provided to each of the participant with an invitation to contact whenever deemed helpful and necessary.

3. Quality Assessment of Training

It appears that the training was well received by the participants. There was always lively participation during the lectures as well as additional questions being asked during breaks. There was also strong participation and contribution to group assignments. The training course fell on a week with one public holiday and a day with a full day general meeting for all AAWSA staff. In addition, the final day was a Saturday, which is not a working day for AAWSA staff. All participants convened for training on each of the three days that would have been 'off work' days, indication strong interest in the training.

Feedback forms were handed to the participants at the end of training and a summary of the feedback is shown in Appendix 4. The results are encouraging and indicate that the training did meet, perhaps even exceed, the standards expected by the participants.

The feedback form was divided into four sections: relevance of course content, quality of course design, quality of instructor, and participants' comments. The overall grading appears to indicate that participants found the training of relevance to their daily work and that they were generally satisfied with the quality of the training instructor. It appears that improvements can be made in the course material issued to participants, by tailoring it to better reflect waste water issues in the Ethiopian context. From the grading, and comments, it also appears that the duration of training was found too short for all the issues covered.

The AAWSA general manager, Ato Getachew Eshete, also indicated that the training met AAWSA's expectations. In his closing address, he stated that from conversations with participants he concludes that the training was well received and very useful for the AAWSA. In particular, he thanked the Partners for Water and Sanitation country manager, Ato Melkamu Jaleta, for his efforts to make the training happen. Ato Getachew Eshete also stated that the AAWSA is keen and committed to continue work with Partners for Water and Sanitation on similar capacity building projects.

4. Recommendations

The training session in May 2009 was the first since the start of cooperation between the AAWSA and Partners for Water and Sanitation. All indicators suggest that it was a worthwhile undertaking for all parties involved and that more training sessions should be planned.

It appears that the training contents were relevant in the context of the AAWSA and provided a useful starting point for more detailed training sessions. Fewer course subjects should be chosen for future six day courses to allow more time for detail and solving of practical problems.

Five key recommendations (KR) result from the training session. Unfortunately, due to time constraints, the AAWSA and Partners for Water and Sanitation did not have the opportunity for a final valuation and discussion of future activities. The recommendations in this paragraph, therefore, reflect the thoughts of the author.

- KR 1:** Incorporation of, at the time of training, ongoing AAWSA projects in the training was extremely useful. It made the course more relevant for the participants and, in addition, may have shown ways of problem solving different to the ones used prior to the information exchange. Future training sessions should, therefore, be even more project based. This requires AAWSA to identify suitable projects for both training and information exchange. Providing training on the bases of ongoing projects will result in more efficient use of staff time.
- KR 2:** It appears that data recording at AAWSA, although currently practiced, would benefit from external input. In addition, AAWSA uses sewer CAD as a design, modelling and data recording tool, but during the training it became apparent that it may not be utilised to its full potential. It would be beneficial if training in these fields could be considered as a matter of priority.
- KR 3:** It is recommended to undertake at least two six days training sessions a year to keep the current positive momentum going and achieve a broad lifting of AAWSA's technical skills base. Additional and targeted short term training courses can be arranged as need arises. Training could be provided by an Ethiopian organisation or person with the appropriate skills. If there is no institute or person with the required skills can be found locally, Partners for Water and Sanitation could assist by providing the appropriate expertise.
- KR 4:** Staff training and other company development activities require sustained effort and even if they are entered in the annual plan are often difficult to accommodate amongst all the other daily pressures. Not to loose focus, it is recommended to plan monthly meetings between AAWSA and Partners for Water and Sanitation. These meetings should be used to review progress in cooperation, identify new and changing training and support requirements, and should always end with an assignment to each of the participants to look into possible ways of addressing an issue that provides potential for cooperation.
- KR 5:** It could be beneficial for AAWSA to entrust three to four of its technical staff with the role of training champions. This group of people should identify training needs, have the experience or be trained to provide in house training, and should directly liaise with a designated group of Partners for Water and Sanitation experts in all matters of training and technical queries.

Besides continuing training activities, all recommendations made in December 2008 in the *Report on 'Needs Assessment Visit'* and *'AAWSA Activity Schedule'* are still relevant and should be pursued, although the time schedule needs reviewing.

5. Conclusions

The training on sewer network design was the first of its kind since the start of cooperation between AAWSA and Partners for Water and Sanitation.

It appears that the training was worthwhile for all stakeholders and should be followed by further training sessions. Planning for the next session should start as soon as possible and a second training session should ideally be run before the end of 2009.

6. Appendices

Appendix-1: *Training Schedule - Overview*

		13:00 - 14:50	14:50 - 15:10	15:10 - 17:00
Monday	25/05/2009	Introduction & General System Performance Requirements	Break	Sewer Design 1
Tuesday	26/05/2009	Sewer Design 2	Break	Sewer Design 3
Wednesday	27/05/2009	Pumping Station Design 1-A	Break	Pumping Station Design 1-B Pumping Station Design 2-A
Thursday	28/05/2009	Pumping Station Design 2-B	Break	Combined Sewer Overflows
Friday	29/05/2009	Discussions of Current AAWSA Projects	Break	Proposal for Current AAWSA Projects and Presentations
Saturday (morning session; 09:00 – 13:00 h)	30/05/2009	Survey & Documentation	Break	Modelling Principles Course Wrap Up

Appendix-2: Detailed Training Schedule

Time	Monday
13:00 - 14:50	1) Introduction (ca 20min) 2) General System Performance Requirements 2.1) Familiarising with AAWSA system 2.2) Compare / contrast with Scottish Water system & Systems from other countries 2.3) Filter the areas where standards from other countries can be transferred to AAWSA 2.4) Determine the areas that need AAWSA specific solutions 2.5) Determine the areas to be included in the training sessions
14:50 - 15:10	Break
15:10 - 17:00	3) Sewer Design 1 3.1) General Sewer Layout 3.2) Combined and separated networks 3.3) Pipe gradients and roughness 3.4) Pipe materials and their properties 3.5) Pipe bedding and cover 3.6) Pipe location (clearances to other services, crossings, loads, etc) 3.7) Pipe access and change in direction and gradients, pipe drops 3.8) Access spacing and construction of access chambers 3.9) Overflows 3.10) Bifurcations 3.11) Inverted siphons & pipe bridges
Time	Tuesday
13:00 - 14:50	4) Sewer Design 2 4.1) Dry weather flows in pipes 4.2) Storm flows in pipes 4.3) Settling and transport velocities in pipes 4.4) Hydraulic headloss in pipe connections 4.5) Surcharge in pipes 4.6) Network flooding 4.7) Hydraulic driving head through inverted siphons 4.8) Septicity in pipes
14:50 - 15:10	Break
15:10 - 17:00	5) Sewer Design 3 5.1) Group work 1: Worked example calculating the following in a foul only network - daily peak flow, minimum pipe sizes required, daily minimum and maximum flow velocities with determination of minimum gradients required.

Appendix-2: Detailed Training Schedule

Time	Wednesday
13:00 - 14:50	6) Pumping Station Design 1-A 6.1) Siting and layout (general) 6.2) Pumps (submersible, grinder, shaft, dry mounted, screw) 6.3) Pump selection 6.4) Flow relief and overflow structures 6.5) Septicity in pump well (odour issues)
14:50 - 15:10	Break
15:10 - 17:00	6) Pumping Station Design 1-B 6.6) Valve chambers 6.7) Electric connections and energy consumption 6.8) Pump control 6.9) Maintenance / Health & Safety issues 7) Pumping Station Design 2-A (rising mains) 7.1) Alignment of rising mains and crossings 7.2) Velocities in rising mains 7.3) Detention time and rising main septicity
Time	Thursday
13:00 - 14:50	7) Pumping Station Design 2-B (rising mains) 7.4) Water hammer and material selection 7.5) Air vents in rising mains 7.6) Rising main entry to access chambers 7.7) Hydraulic head in pipes 7.8) Thrust blocks
14:50 - 15:10	Break
15:10 - 17:00	9) Combined Sewer Overflows 1 9.1) Use of CSOs 9.2) Siting and general layout 9.3) Pass forward control 9.3.1) Orifices 9.3.2) Weirs 9.3.3) Vortex flow control 9.3.4) Constant flow control 9.4) Outfall construction & consideration of storm water levels in receiving water 9.5) Introduction to CSO screens 9.6) CSO maintenance and Health & Safety issues

Appendix-2: Detailed Training Schedule

Time	Friday
13:00 - 14:50	10) Discussion of current AAWSA projects 10.1) First time connection of mature residential area 10.2) First time connection of mature residential area with development of large greenfield site upstream due to be developed; issues with pipe next to river 10.3) Pipe bridge 10.4) Rehabilitation of broken trunk sewer
14:50 - 15:10	Break
15:10 - 17:00	11) Proposals for current AAWSA projects and presentations 11.1) Group work 1: How to best undertake first time connection of the Lideta area. The development to be connected is a long established residential area. A large greenfield site is due to be developed upstream of Lideta and sewer capacity must be designed accordingly. The sewer runs next to a river and the river's banks retreat further with each rainy season. The sewer needs to be protected from eventually falling into the river. 11.2) Group work 2: A trunk sewer needs to cross a river. The open width is approximately 25 metres and the depth from the upstream sewer to the bottom of the river is approximately 7 metres. Detail the options. 11.2) Group work 3: A trunk sewer has been cut during excavation to a multi storey building. Detail the best options for its rehabilitation.
Time	Saturday
09:00 – 10:50	12) Survey & Documentation 12.1) Asset survey requirements 12.2) Asset survey field recordings 12.2) Numbering conventions for sewer lines (discussion on what system could be suitable for AAWSA) 12.3) Asset numbering convention 12.4) Data storage and maintenance
10:50 – 11:10	Break
11:10 - 13:00	13) Modelling Principles 13.1) General drainage area modelling principles 13.2) Inputs required for modelling 13.3) Data gathering, recording, confidence grading, usage and storage 13.4) Hydraulic sewer models (short introduction into Infoworks, Extran & Storm) 13.5) Modelling uses, advantages and limitations 14) Course Wrap Up

Appendix-3: List of Training Participants

No	Name	Organization	Responsibility	E-mail
1	Mulualem Kifle	AAWSA	Case Manager	muluak200@yahoo.com
2	Nasiro Mohammednur	AAWSA	Supervisor	nasiriomohamednr@yahoo.com
3	Tareessa Workneh	AAWSA		tares@yahoo.com
4	Gemechis Tilahun	AAWSA	Case Manager	gamechis_t@yahoo.com
5	Ebrahim Adem	AAWSA	Sewer Net. Con. Eng	ebroamyadem@yahoo.com
6	Getu Mulissa	AAWSA	Supervisor	sgetu_mulisa@yahoo.com
7	Getachew Demeke	AAWSA	Supervisor	getachewdemeke@yahoo.com
8	Adey Birhanu	AAWSA		adey911berhanu@yahoo.com
9	Habteab Kindeya	AAWSA	Supervisor	
10	Rekik Tsegaye	AAWSA	Supervisor	rekiktsegaye@yahoo.com
11	Alemayehu Tadesse	AAWSA	Supervisor	chilaloterara@yahoo.com
12	Nuri Mohammed	AAWSA	Case Manager	Nurimed2002@yahoo.com
13	Gezahegne Gebeyehu	AAWSA	Operation Head	Mukog200@yahoo.com
14	Shorit Zewdie	AAWSA	Sanitary Engineer	zewdieshorit@yahoo.com
15	Selamawit Teshale	AAWSA	Supervisor	
16	Tesfaye Worede	AAWSA	Supervisor	tesfayeworede@yahoo.com
17	Tebike Tafesse	AAWSA	Sanitary Engineer	tafteb@yahoo.com
18	Elias Nasser	AAWSA	Supervisor	elias_nasser@yahoo.com
19	Esayas Kebede	AAWSA		isayatu@yahoo.com

Appendix 4: Participants Feedback on Training

	Responses	Score (1-6)
Regarding relevance of course content	5.50	
<i>What I learnt in this course will help me improve my performance?</i>	18	5.5
<i>Material and issues were current and worthwhile</i>	17	5.23
<i>The course was relevant to my needs</i>		5.72
Regarding the quality of course design	5.09	
<i>The structure and institutional modes of the course encouraged learning</i>	18	5.22
<i>The course objectives were fully addressed</i>	18	5.27
<i>The course actively and effectively engaged me through-out</i>	18	5.27
<i>The duration of the course was just right</i>	18	4.27
<i>Overall this was a high quality course</i>	18	5.11
<i>Relative to other training that I have attended I would rank this course as one of the best</i>	17	5.41
Regarding the quality of the instructors	5.68	
<i>The instructors encouraged and responded well to questions</i>	17	5.64
<i>The instructors have knowledge in the course content</i>	18	5.66
<i>The instructors treated participants with respect</i>	18	5.77
<i>The instructors were well prepared and organised</i>	18	5.66
<i>The pace of instruction was just right</i>	18	5.5
Comments		
<p>Please comment on any of the statements in the previous sections, particularly those you disagree with.</p> <ul style="list-style-type: none"> • The duration is enough to catch up the relevant things • The course content is large but the time given is too short and also the training room is not comfortable • I am very happy to take this training but the time of the training needs additional time • Right, the duration of the course was too short • Indeed the course must be long enough • The duration of the training must be a little bit longer like more than 3 weeks. • The time of the training is too short just it seems running and we did not discuss in detail • As much as possible you should improve the time arrangement because the course needs long time • The way Dr. Adolph gives lecture is very appreciable so thank you and the duration of the course is too short and please try to improve • It was a very interesting way of presentation • It was very comparative with the realities. If a serious of similar trainings can be given as convenient and I think the training was fair • The last few weeks were very much interesting and I would be glad if this would continue • It was sufficient enough at this particular training 		

Where there any aspects of the course that you think should be improved?

- If practical photos and elaboration movies were added, would be more fantastic
- Design of sewerage in general
- I would be happy if this type of the on job training would be continued
- The trainees could go out to the field with the instructor for more elaboration and questions and so on
- The course that we got were more focused on theory but for the future it is better to support it technically
- The course was interesting indeed but for the future if you give us a training on water supply and treatment we would be more grateful for us and to AAWSA
- The course should be related to treatment plant design
- Just it seems experience sharing. In fact the training should be given in particular problems the organization is facing. And also update information and technologies such as modelling and data management
- The course is good but if it includes training of software it would be more good
- Designing sewer
- It is the type of training that I have never seen before
- I suggest may be 3 weeks or more time is quite enough to cover the course
- I am so happy to take the training and for the future please help our people in the health status and we need more training
- If we could take the Sewer software programme that one is very good
- We need a training on Sewer CAD
- In areas of maintenance and connection of secondary lines

Which parts of the course did you find useful?

- Almost all parts of the course were useful
- The method of solving the maintenance of the breakdown part is useful
- The modelling part (though the time was too short)
- The sewer modelling part and pump design were very useful
- Pump station design and manhole design
- None of the parts was wasteful I would say and the comparative part of the work with an already developed network of the UK
- Especially the part of maintenance and river crossing is very well

General comments.

- The training acquired as a good knowledge for design especially in selecting routes and ways of construction. Some practice and method of construction in Scotland is a good example for Ethiopia.
- As a novice in this kind of participation, I consider myself lucky and whenever convenient, different types of training like this one may develop the city's capacity
- Since the course is very important and for designing and proper recording of data continuity must be there between AAWSA and partners for water and sanitation
- I am really very glad and I want to thank Ato Melkamu for his cooperation to prepare such an interesting course
- You are doing good because you are helping our developing country by sharing your good experience what you had in your country
- It is very essential that such a training should be continued for other organizations in the country

to develop capacity of professionals

- The course helped me to compare problems with the European type and gives me a very good solution to the problem
- I thank for all PAWS members and to continue the help for all other officers. PAWS has a knowledgeable instructor Dr. Adolph and thank you
- I would like to thank Partners For Water and Sanitation
- Help, Help, Help us by giving us a training like this one
- Thank you Dr. Adolph
- It is good if the partners continue with other courses related with water and sanitation