The Jordan Component of

The Sustainable Development of Dry Lands In Asia and the Middle East:

Jordan Visit Report
August 17 to August 28, 2006

Report Number
2006-005

Prepared by

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I. Introduction

In an attempt to meet with the Jordanian partners of the Sustainable Development of Dry Lands Project referred to in this report as the project and to further develop fiscal year 2006-2007 scope of work and present it to the USAID – Amman mission, Mr. Robert Freitas, the project director and Dr. Akrum Tamimi the project coordinator for The University of Arizona Jordan component visited Jordan between August 17 and August 25, 2006. Dr. Tamimi extended his visit until August 28, 2006 to have more discussions with the project partners for current project activities.

The meetings with the Jordanian partners and with USAID mission in Amman went well. Dr. Tamimi will be scheduling another visit to Jordan to visit with USAID in the second half of September 2006 to discuss the budget for fiscal year 2006-2007.

This report is being compiled jointly by Mr. Robert Freitas and Dr. Akrum Tamimi detailing the meetings and findings of the visit.

II. Objectives of the Visit

The objectives of the visit to Jordan in August are as follows:

1. Have multiple meetings with Badia Research and Development Center (BRDC) to discuss current activities and to fine tune fiscal year 2006-2007 Scope of Work referred to in this report as FY 06-07 SOW.
2. Have a meeting with United Stated Agency for International Development (USAID) mission in Amman to present FY 06-07 SOW and to receive feed back.
3. Visit the Secretary General at Water Authority of Jordan (WAJ) to present an update on previous and future project activities conducted in cooperation with WAJ. In addition gather additional proposed activities to include in the SOW.
4. Have an exit meeting with USAID mission in Amman to present an updated FY 06-07 SOW taking into consideration feedback given in the first visit.
5. Meet with Royal Scientific Society/Environmental Research Center (RSS/ERC) to discuss current activities and future proposed activities.
6. Meet with University of Jordan's Water and Environmental Research Studies Center (WERSC) to discuss and get feedback on the anaerobic study and present future proposed activities which might involve them.
7. Visit Jordan University of Science and Technology (JUST) to discuss the distance learning course that will be offered in fall 2006 and to get an update on the extension activity.
8. Visit Madaba Wastewater Treatment Plant (WWTP) to check on the weather station, the modeling study, and to evaluate the prospect of the proposed future activities at the Madaba WWTP.

To fulfill those objectives an itinerary of the visit was developed and is presented in appendix A of this report.

III. Jordan University of Science and Technology

On Monday, August 21, 2006, Mr. Mohammad Shahbaz, Mr. Robert Freitas, Dr. Saad Al-Ayyash and Dr. Akrum Tamimi traveled to Irbid and met with Dr. Wajih M. Owais, President of Jordan University of Science and Technology (JUST)

Mr. Shahbaz presented the vision for offering distance learning courses at JUST jointly with The University of Arizona. He explained that JUST has the capabilities to be a regional focal point to offer distance learning courses and academic programs in the Middle East utilizing video conferencing capabilities available at the university. He also explained that the first distance learning course proposed to be offered in the fall of 2006 will be the first of a kind and will test the ability to conduct such courses in the future.

Mr. Robert Freitas indicated in the meeting that a long history of cooperation has been going on between the Sustainable Development of Dry Lands Project and JUST and mentioned the extension study that is being funded this year with Dr. Ziad Ghazawi, the participation of JUST faculty members and staff in the wastewater study tour to Arizona, the support of attending the salinity conference in Pakistan and providing support for annually updating the TEEAL electronic library. In addition, Mr. Freitas followed with the president the old business related to the Memorandum of Understanding (MOU) compiled and signed by both The University of Arizona president and Dr. Owais himself. The signed copy of the MOU was provided to the JUST president.

The distance learning course logistics especially the technology side of the delivery were presented by Mr. Freitas. Dr. Tamimi explained that following initial planning meetings and discussions between The University of Arizona and JUST faculty and project personnel in the first quarter of 2006, the distance learning class concept was formally presented to JUST administration in May, 2006 to offer the course as a summer course. The lack of progress caused a decision to be made by BRDC and The University of Arizona faculty members to postpone the course offering until the fall of 2006 due to short time available to market the course in the summer session. A meeting was held with Dr. Turki Obaidat, the Dean of the College of Engineering, during which logistics were discussed and a preliminary proposal was developed and sent to JUST for comments. Based on the comments obtained during the discussions period, Dr. Tamimi sent a complete proposal to Dr. Turki early July 2006 for consideration at the deanship and the Civil Engineering department levels for approval.

The issue of credit to non-student participants coming from the different governmental agencies was discussed and Dr. Owais indicated that there is no problem in registering non-student participants for audit or for credit. He explained that the registrar office will be able to give them a special registration number and at the end of the semester they will be able to receive a grade and credit for the course they completed. President Owais also indicated that the credit hours can be used towards a master's degree at JUST if and only if the participant gets accepted at JUST for a master degree and the department accepts the credit hours and transfers them to be used towards the master's degree. Dr. Owais explained that tuition will not be waived for participants as was indicated earlier during previous visits to JUST. The participants will be responsible to cover the tuition fees at about JD60.00 per credit hour. The course will be taught as long as at least four students are registered.

At the end of the meeting president Owais requested that The University of Arizona and BRDC team visit the Prince Haya Biotechnology Center (PHBC).

The Public Relations department at JUST accompanied Mr. Freitas, Dr. Al-Ayyash and Dr. Tamimi to the PHBC where they were greeted by:

Dr. Said Jaradat, Director
Prince Haya Biotechnology Center
Tel: +962-2-720-0600, ext 45056
Fax: +962-2-720-0632
Cell: +962-79-590-3713
Email: sjaradat@just.edu.jo

Dr. Jaradat presented the history of the center and indicated that it was inaugurated two years ago. A tour of the different labs was conducted and Dr. Jaradat talked about the different lab equipment and analysis that can be performed at the center. The center has labs that can test for: all environmental parameters, cloning, 14 trace elements, protein measurements, endocrine disruptors and other specialized tests.

During the visit two female students were conducting analysis on wastewater coming from the JUST wastewater treatment plant. They indicated that it was discovered that high concentrations of heavy metals were found in the wastewater and they were trying to determine the source of the heavy metals. Dr. Tamimi indicated that their work stems from work that the project started in 2004 through a sludge/biosolids characterization study conducted by RSS/ERC through which the sludge/biosolids from three wastewater treatment plants in Jordan were characterized. One of these treatment plants selected in the study was the JUST treatment plant and high concentration of heavy metals were reported in the study. Dr. Tamimi indicated that he is very happy that the university is trying to pinpoint the source of heavy metals so as to eliminate them.

A meeting with the dean of the college of engineering followed. Dr. Turki Obaidat with the presence of Dr. Ziad Ghazawi met with Mr. Freitas, Dr. Al-Ayyash and Dr. Tamimi. He emphasized the interest of JUST to conduct such courses and promised to facilitate the activity and do whatever is necessary to have the course offering succeed. He appointed Dr. Ziad Ghazawi as the coordinator of the course and the co-teacher for the topics that will be covered by JUST faculty. He indicated that the coordination of the course and the teaching involved will count as three credit hours towards Dr. Ghazawi's semester academic load.

Dr. Obaidat also indicated that he will work closely with Dr. Ghazawi to make sure that the course be listed for the fall 2006 semester and an announcement will be distributed to the different departments to encourage graduate students to register for the course. In regard to the non-student participants, Dr. Turki indicated that either JUST or BRDC or both can send a letter to the different governmental agencies and organizations encouraging them to take advantage of such a valuable course.

After the meeting was over, a meeting was held with Dr. Ghazawi to discuss the extension activity and the progress on that activity was reported by Dr. Ghazawi. Contracting and fund transfer issues were also discussed and clarified between JUST, BRDC and The University of Arizona.

A test run of the distance learning course was scheduled for 4:00 p.m. Amman time, 6:00 a.m. Tucson time to test the technology of delivering lectures utilizing video conferencing

capabilities at both The University of Arizona and JUST. Mr. Freitas, Dr. Al-Ayyash, Dr. Ghazawi and Dr. Tamimi attended the lecture that took place between 4:00 p.m. and 5:15 p.m. Amman time which is the same time the course will be offered during the fall. The team from The University of Arizona and the team from JUST communicated well using the technology and few minor fixings were made to ensure best picture and best voice. The test was a success.

IV. Royal Scientific Society

On Tuesday, August 22, 2006 a meeting was held at RSS/ERC. Present were: Mr. Freitas, Dr. Al-Ayyash, Dr. Tamimi, Dr. Bassam Hayek and Engr. Wael Suleiman.

The application of biosolids at Ar-Ramtha agricultural station was presented by RSS/ERC indicating that the laboratory analysis for the soil and the crops were completed and the statistical analysis for the experiment has been conducted. RSS/ERC is working on the final report and they are expecting to have the final version of it ready by the end of September 2006.

The modeling of biosolids treatment study at Madaba WWTP was started at the beginning of August and since the operators at the treatment plant did not receive any directions in regard to the experimental drying bed at which the experiment is conducted, the biosolids were removed after 2 weeks of drying and before complete treatment. The experiment was repeated with proper instructions given to the operators.

Activities in which RSS/ERC will be a primary partner for the FY 06-07 SOW were presented to RSS/ERC for feed back. These activities are as follows:

1. Advanced Biosolids Laboratory Training
2. Required Biosolids Laboratory Training
3. Sludge Treatment
    - Development of Drying Bed Sludge Treatment Method to Arrive at a Permitted “Process to Further Reduce Pathogens” (PFRP) (Madaba)
    - Modeling Biosolids Treatment in Jordan
4. Biosolids Reuse
    - Application of Treated Biosolids to Land Irrigated with Effluent (Madaba)
5. Management Practices of Sludge and Biosolids in Jordan
    - Manual for Management of Biosolids in the Drying Beds at the WWTP Level (Volume I)
    - Laboratory Procedure Manual (Volume III)
    - Management Practices of On-farm Biosolids Application Manual (Volume II); this activity will be completed in conjunction with an activity that JUST is doing through the extension activity funded from this project for the current fiscal year.

The specific details of these activities will be available later through the final version of the FY 06-07 SOW when it gets approved by USAID and funds are received by the project.

RSS/ERC indicated that they will be interested in working with the project to complete the proposed activities. Mr. Freitas indicated that Dr. Tamimi will make another visit to

RSS/ERC on Sunday 8/27/06 to further discuss the proposed activities and to answer any questions that RSS/ERC might have.

Dr. Tamimi visited with RSS/ERC and met with Engr. Wael Suleiman who indicated that RSS/ERC has no problem with the activities and they will be ready to work with the partners and The University of Arizona faculty members to develop the proposals for peer reviews and to conduct the work once the proposals are approved by the project.

V. United Stated Agency for International Development – Amman Mission

On Tuesday, August 22, 2006, Mr. Mohammad Shahbaz, Mr. Robert Freitas, Dr. Saad Al-Ayyash, Dr. Raed Altabini and Dr. Akrum Tamimi met with Mr. Ross E. Hagan, Deputy Director of the Water Resource and Environment Office at the USAID - Amman Mission. Mr. Mohammad Shahbaz and Mr. Robert Freitas thanked Mr. Hagan for allowing the meeting to take place.

Mr. Freitas pointed out the purpose of the Jordan visit and pointed out the multiple meetings that have been scheduled to visit the different Jordanian partners. He gave a brief summary of the ongoing activities in Jordan and indicated that Dr. Tamimi will be presenting the proposed Scope of Work for fiscal year 2006-2007.

Mr. Freitas stated that the coming fiscal year will be the last of the 5 year project. But he explained that the cooperative agreement between IALC and USAID has an authorized level of $10 million across four project counties of which around $7.5 Million would have been used by the end of fiscal year 2006-2007. Mr. Freitas expressed an interest on behalf of the project to extend the cooperative agreement for additional two years during which the project will be funded from the mission side performing activities that USAID – Mission expressed interest in:

1. Integrated water resources
    - Rangeland community based projects
    - Hydrology
    - Improved soil, biomass and species selections on rangeland
2. Water policy studies
3. Propagation of native plants and high economics value crops - Natural Product Center involvement (The University of Arizona)
4. Development of natural products - potential funding from USAID and Global Development Alliance (BRDC & NMSU)
    - Development of greenhouses and controlled environmental agriculture
5. Development of demo farms for biosolids and wastewater (Zarqa River Valley) forage and woody species production
6. Date palm propagation
    - Germo-plasm development –on going activity BRDC under separate funding
7. Aquaculture – Integrated with farm production with efficient use of irrigation water – south or Jordan River Valley. Reduce application of chemical fertilizer. Environmental research lab (U of A) – NMSU markets and financial analysis
8. Distance learning opportunities in offering courses in:
    - Water resources and environment
    - Water economics

- Agro-business and marketing
- Modeling and biostatistics
- Green house and controlled environmental technology

9. Other interests that USAID – Amman Mission determines.

Mr. Freitas also indicated that Dr. Tamimi will be relocating in Jordan to better support the activities of the project this coming fiscal year and for the proposed two additional years. Mr. Freitas also explained that the capabilities available at the International Arid Lands Consortium (IALC) member institutions will be mobilized to answer the required expertise. The University of Arizona, New Mexico State University and University of Texas A & M expressed interest within the IALC to providing technical assistance to the project in Jordan in the areas presented earlier.

Mr. Ross Hagan indicated that the funding level for the mission has been cut from Washington by 10% across the board except for construction projects. He gave no explanation of the impact of that on the project or the proposed two years of funding extension requested by Mr. Freitas.

Dr. Akrum Tamimi handed out a copy of the 3rd draft of FY 06-07 SOW labeled for discussion only and presented and explained all items. Discussions of certain items went on during which Mr. Mohammad Shahbaz and other team members explained and answered particular items and questions.

The headings, titles and subtitle of the activities presented at the meeting are as follows:

1. Conference: "Can Water Resources Be Sustained in Dry lands? The Challenge for the Present and Future"
2. Capacity Building: Distance Learning Courses
    a) Reclaimed Water Irrigation Management
    b) Efficient Irrigation System and Network Design
    c) Economics of Water Use Efficiency
3. Capacity Building: Technical Laboratory Training
    a) Advanced Biosolids Laboratory Training
    b) Required Biosolids Laboratory Training
4. Biosolids Related Activities
    a) Sludge Treatment
        i. Development of Drying Bed Sludge Treatment Method to Arrive at a Permitted "Process to Further Reduce Pathogens" (PFRP) (Madaba)
        ii. Modeling Biosolids Treatment in Jordan
    b) Biosolids Reuse
        i. Application of Treated Biosolids to Land Irrigated with Effluent (Madaba)
    c) Management Practices of Sludge and Biosolids in Jordan
        i. Manual for Management of Biosolids in the Drying Beds at the WWTP Level (Volume I)
        ii. Management Practices of On-farm Biosolids Application Manual (Volume II)
        iii. Laboratory Procedure Manual (Volume III)
5. Anaerobic Low Energy & Low Cost Wastewater Treatment Activities
    a) The Development of Anaerobic Wastewater Treatment Technology for Jordan
        i. Septage Characterization

ii. UASB Technology Development

b) Management Aspects of Full Scale UASB Anaerobic Treatment Plant Round Table Seminar

6. Rangeland Responses under Biosolids Application
7. Linkages for On-Farm Applications and Technology

Mr. Hagan indicated that he does not have the funding numbers from Washington; and he expected to have those around the middle of September, 2006. Dr. Tamimi will be making an appointment to visit with Mr. Hagan accompanied by BRDC to receive information concerning the SOW and to obtain the funding level possible which will enable the IALC to determine activities to be funded for the fiscal year.

VI. Madaba Wastewater Treatment Plant

On Wednesday, August 23, 2006, Mr. Robert Freitas and Dr. Akrum Tamimi were accompanied by Dr. Nisreen Al-Hmoud and microbiologist Showgy Ma'ayeh to Madaba WWTP in the city of Madaba 30 Km south west of Amman.

Madaba's coordinates are: N 31° 43′ E 35° 48′ and it has an elevation of 785 meters above sea level. Madaba climate can be summarize with a 30-year yearly average temperature of 16.9° C, an average monthly maximum temperature of 24.6° C occurring in July and an average monthly low temperature of 7.8° C occurring in January.

At arrival the team was greeted by Engr. Abdel Karim Jarrar, Mechanical Engineer
Email: karimjarrar@yahoo.com
Telephone: (W) +962-5-324-4729; (H) +962-6-534-7925

Engr. Abdel Karim Jarrar, the treatment plant manager, gave an explanation of the plant history design and operation. The following is information obtained through multiple visits to Madaba WWTP, discussions with WAJ personal and from the "Management Practices Of Sludge and Biosolids in Jordan" report generated by the biosolids ad hoc committee in cooperation with RSS/ERC in November 2005 and from analysis and calculations performed by the authors.

1) The Treatment Plant

Madaba wastewater treatment plant started operation in (1988). The treatment system utilized stabilization ponds until 2002 when the system was converted to a mechanical activated sludge process. The treatment plant currently serves about (50,000) inhabitants living in Madaba city and some industry represented by a soft drink factory and an elevator factory. Also septage wastewater is hauled to the plant and dumped into the screening area as shown in figure 1.

Table 1 shows the design and actual hydraulic and organic loads for the treatment plant for 2002 through 2005. The trend shows an increase in both hydraulic as well as organic loads; however, the treatment plant is still operating below its design capacity but the organic load is exceeding the design capacity. It is believed that the reason the organic load is too high is because of the quality of the uncontrolled dumping of septage into the treatment plant. Studies conducted by University of Jordan showed that Jordan septage has high organic matter content.

Figure 1: Septage Wastewater Dumped into Madaba WWTP Inlet (*Photos by A. Tamimi, August 23, 2006***)**

Figure 2 shows a schematic flowchart of Madaba wastewater treatment plant. The treatment operation starts with preliminary treatment including screening and grease removal. The secondary treatment (activated sludge/extended aeration system) follows and consists of an aeration tank, two secondary clarifiers, and two polishing ponds. Treated effluent is stored in polishing ponds and is used to grow fodder on-site by farmers.

Table 1: Actual and Design Loads for Madaba Wastewater Treatment Plant

Parameter	Unit	Actual Load				Design Load**
		2002*	2003*	2004*	2005**	
Inflow	m^3/day	4,176	4,422	4,542	5,500	7,600
BOD_5	mg/l	1,045	1,137	1,301	1,400	950
TSS	mg/l	965	1,218	1,226	2,000	1,000

*Source: WAJ, Wastewater Operating Systems Directory annual report, 2004.
**Source: WAJ Reports.

2) Sludge/Biosolids System

The sludge treatment unit consists of two thickeners followed by drying beds. Table 2 shows actual and design values for the drying beds operated at Madaba WWTP.

The outflow of the thickeners' disposed sludge is estimated at 170 m^3/day, which is below the design value. That translates into a volumetric production of about 5 m^3/day of dewatered biosolids which is the value quoted from the treatment plant manager.

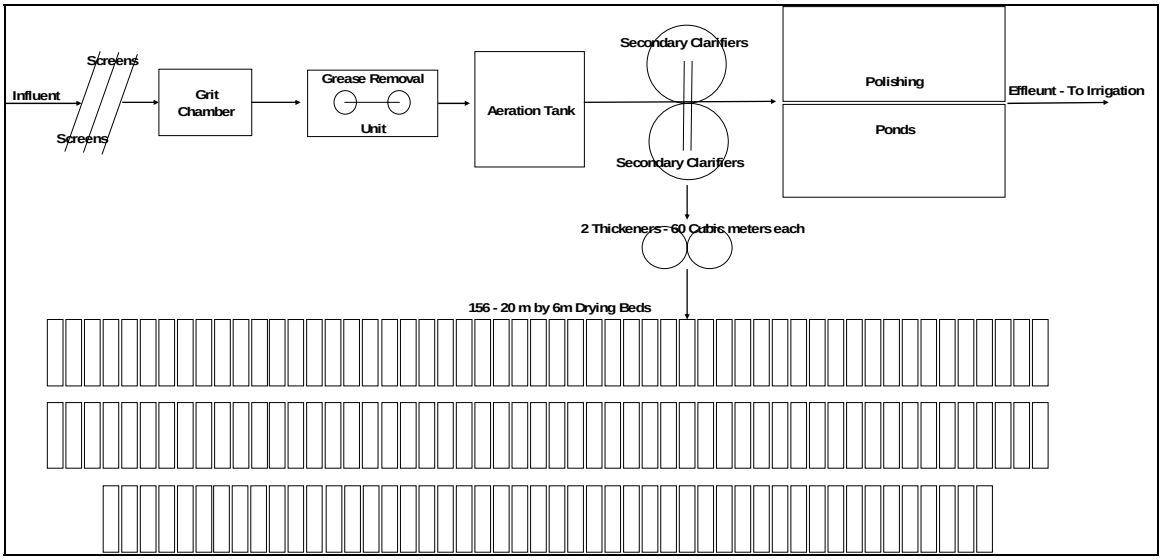

Figure 2: Schematic Flowchart of Madaba

The design daily flow rate of 300 m^3/day with 3% Total Solids (TS) and a sludge depth of 35 cm when placed in the drying bed requires a drying beds total area of 38,571 m^2 which is half the actual design value shown in table 2 if the required drying time of 45 days is applied according to the JS: 1145/2006.

Table 2: Actual and Typical Design Values for the Drying Beds at Madaba WWTP

Parameter	Unit	Actual Design*	Typical Design**
Thickeners Disposed Sludge (TS=3%)	m^3/day	250-300	
Disposed Solids from Thickeners (Biosolids Generation from the Drying Beds)	m^3/day	7.5 – 9***	Calculated from TS & Daily Volumetric Flow Rate
Number of units	Count	156	
Length of Drying Beds	m	20	6 - 30
Width of Drying Beds	m	6	6
Drying Beds Total Area	m^2	18,720	(0.16-0.23 m^2/capita)
Sludge Depth When Placed in Drying Bed	cm	35	20 - 30
Detention Time in Drying Beds	days	20 - 30	Dependent on Biosolids Quality
Aggregate Layer Depth	cm	90	23 - 30

*WAJ Documents and Manager of Madaba WWTP
**Metcalf &Eddy, third edition, 2003
***Calculated by Report Authors

For today's daily flow rate of 170 m^3/day, a 3% TS, 35 cm sludge depth when placed in the drying beds and an efficient placing and removing of dried biosolids from the drying beds, an area of 21,857 m^2 is required which is about 20% higher than the available drying beds total area. Hence one can conclude that the drying beds are under designed now and when the treatment plant reaches its design capacity.

The sludge/biosolids operators complained about the design of the drying beds itself since the opening through which the front end loader enters and exits to haul out the dried biosolids do not allow for more than 65% of the dried biosolids be removed using the front end loader. Laborers are usually employed to empty the biosolids.

From the meeting Mr. Freitas and Dr. Tamimi had with the Madaba WWTP manager, it was discovered that the sludge is placed in the drying beds only 6 months of the year: May – October, for about 3 to 4 weeks time periods for treatment and the generated biosolids (about 5 m^3/day) is buried in the agricultural fields and covered with soil. For the other 6 months: November – April, no sludge is placed into the drying beds due to winter conditions and the liquid sludge is hauled about 45 km to Ein Ghazal station and dumped into the carrier of wastewater to As-Samra WWTP. The same hauling and dumping of liquid sludge is practiced for at least 5 WWTPs in the Amman area in the winter time as indicated by the treatment plant operators and manger. This practice increases the organic load at As-Samra WWTP especially during the winter months.

This project will work on developing a methodology to treat sludge in drying beds and produce biosolids compliant with the JS: 1145/2006 throughout the year including the winter months. This work will be based on project previous activities and findings at The University of Arizona during which ploughing the biosolids while in the drying beds and covering the drying beds during winter storms are introduced and practiced.

VII. Water Authority of Jordan (WAJ)

1) Meeting with the Secretary General

A meeting with Engr. Munther Khleifat, Secretary General of WA was set for BRDC and The University of Arizona teams on Wednesday August 23, 2006. The meeting took place at Mr. Khleifat's office and present were: Mr. Mohammad Shahbaz, Mr. Robert Freitas, Dr. Saad Al-Ayyash and Dr. Akrum Tamimi; and from WAJ: Engr. Munther Khleifat, Engr. Saleh Malkawi and Engr. Ahmad Ulimat.

The meeting started with Mr. Shahbaz commenting on the long cooperation that has been taking place between WAJ and the project. A list of WAJ's Involvement in the project's previous and future proposed activities was presented by Mr. Robert Freitas and Dr. Akrum Tamimi. This list is attached to this report as appendix B.

Engr. Khleifat thanked the guests and applauded the cooperation between WAJ and the project. He indicated that there is a big problem facing WAJ in financial over charging by the company running As-Samra WWTP due to the high organic loads coming into As-Samra WWTP. Mr. Freitas pointed out the dumping of septage into Ein Ghazal from the surrounding treatment plants especially in the winter months was discovered and pointed out in the previous section. The Secretary General requested a characterization of septage at Ein Ghazal to be conducted by the project to determine the kind of treatment process will reduce the organic loading that goes to As-Samra WWTP and as a result to reduce the penalty that the As-Samra operating company is charging WAJ for the above agreed upon organics present in the wastewater. As Engr. Khlaeifat explained, WAJ is considering taking the wastewater from Ein Ghazal to pre-treat it away from urban areas using an anaerobic process to reduce its BOD content.

Mr. Freitas indicated that the project is supporting the University of Jordan's Water and Environmental Research and Studies Center (WERSC) to conduct septage characterization and to work on adapting the UASB anaerobic process to low temperatures that occur during

the winter times in Jordan, especially at higher altitudes. He indicated that the characterization can happen at Ein Ghazal through the current activity conducted by WERSC.

This issue was set to be further discussed with WERSC in the meeting scheduled for Thursday, August 24, 2006.

2) Meeting with Reuse Unit

In a second separate meeting at WAJ, Engr. Malkawi and Engr. Ulimat from the reuse unit met with Mr. Freitas and Dr. Tamimi. During the meeting Engr. Malkawi presented a copy of the final draft of the JS: 1145/2006 indicating that the enteric viral testing requirement to produce Type I biosolids (equivalent to Class A in the EPA CFR 503) was taken out of the original standard because many of the agencies don't have the capabilities to test for viruses. Mr. Freitas indicated that there will be capacity building in this area for the Jordanian partners through which lab specialist will be trained at The University of Arizona to test viruses. Dr. Tamimi requested a complete copy of the final draft to look at it since the one received from RSS/ERC earlier in the week was missing a page. Engr. Ulimat indicated that he will email a copy to Dr. Tamimi.

When Dr. Tamimi received the copy via email, he went over it in details and found out that the elimination of the enteric viral testing to produce Type I biosolids does not cause a health risk. The JS: 1145/2006 pathogenic requirements to produce Type I biosolids are listed as follows:

1. Fecal Coliforms density is below 1,000 (MPN per gram of TS); and
2. Salmonella density is less than 3 (MPN per 4 grams of TS); and
3. Helminthes ova concentration is less than 1 viable organism per 4 grams total solids.

This is different from the EPA CFR 503 in that it does not take advantage of the fact that if fecal Coliforms concentration is less than 1,000 MPN per gram of TS then that is an indication that no pathogens are present in the biosolids since fecal Coliforms is used as an indicator for the presence of pathogens.

The other difference between the EPA CFR 503 pathogenic requirement to produce Class A (Type I) biosolids and the JS: 1145/2006 is the treatment processes. In the JS:1145/2006, open air drying beds can be used as a process when the filter media of the bed is sand, the depth of sludge placed in the drying bed is at most 25 cm, and the time period during which the biosolids remain in the drying bed is not less than 45 days.

This is also fine and does not impose a risk since the 3 pathogenic conditions listed above have to be met if the process used is open drying bed or any other process.

The project will make recommendations to WAJ and USAID to modify the JS: 1145/2006 when capacity building is completed for enteric viral testing of biosolids. It will require that the pathogenic required conditions are as follows:

1. Fecal Coliforms density is below 1,000 (MPN per gram of TS); or
2. Using a listed process that will require without testing that:

    a. Salmonella density is less than 3 (MPN per 4 grams of TS); and

b. Helminthes ova concentration is less than 1 viable organism per 4 grams total solids; and
c. Enteric virus concentration is less than 1 PFU per 4 grams total solids.

Drying beds treatment process will be studied through this project and guidelines will be produced to recommend the using of drying bed as a process to generate Type I biosolids without required pathogenic testing to make it easier for the operators and the farmers. The other parameters present in the JS: 1145/2006 have to be tested to designate if the biosolids are of Type I, Type II or Type 3.

VIII. University of Jordan's Water and Environmental Research Studies Center

On Thursday, August 24, 2006 a meeting was held at BRDC headquarters. Present in the meeting were: Dr. Manar Fayyad and Dr. Maha Halalsheh from WERSC; Mr. Mohammad Shahbaz and Dr. Saad Al-Ayyash from BRDC; Mr. Robert Freitas and Dr. Akrum Tamimi from IALC – The University of Arizona.

1) Up-flow Anaerobic Sludge Blanket Activity

The peer reviewed proposal submitted by WERSC to study the Up-flow Anaerobic Sludge Blanket (UASB) wastewater treatment method was discussed. The proposal was approved for funding by the project. This activity will allow WERSC to conduct a study to adapt the low cost and low maintenance UASB process for Jordan's low temperature winters. The UASB process would then be utilized in a hybrid system in treatment plants.

Contracting between BRDC and WERSC was completed and the paper work is being processed at The University of Arizona to have the funds transferred.

2) Septage Characterization

The request made by WAJ's Secretary General presented in details in section VII – 1 above was discussed during the meeting. Dr. Maha Halalsheh indicated that what was presented in the proposal submitted is different from what is requested by WAJ. The proposal is built on determining the characteristics of septage as it is aged by utilizing a reactor and testing the septage on regular basis for an entire year.

What WAJ is requesting is different since WAJ would like to know the characteristics of random composite samples collected at Ein Ghazal from dumping trucks especially in the winter months when liquid biosolids are dumped into the Ein Ghazal station that feeds into As-Samra WWTP.

Mr. Robert Freitas requested that Dr. Halalsheh develop an action plan to do the characterization of septage dumped at Ein Ghazal station and present an estimated cost. Dr. Halalsheh indicated that the action plan including a budget will be ready by the end of September.

3) Management Aspects of Full Scale UASB Treatment Plant Seminar

As indicated in the draft version of the FY 06-07 SOW (see section V-5-b of this report) a seminar was proposed to arrive at lessons learned in managing the full scale Sanhour treatment plant at which the UASB process was used in a hybrid system. Mr. Freitas requested that Dr. Manar Fayyad co-chair the roundtable seminar with Dr. Fatma Al-Gohary from the National Research Center (NRC) in Egypt. Dr. Fayyad accepted being a co-chair of the seminar.

The roundtable seminar will be held in Amman – Jordan during the second half of March, 2007 during which the two operational engineers, who were responsible for running the Ein Ghazal WWTP about 20 or more years ago when the treatment plant used an aerobic process, will be invited to talk about the successes and the failures of the anaerobic system used then. The new technologies and management skills that are available for anaerobic processes today will be discussed to avoid yesterday's problems.

During the seminar a hybrid system that uses the UASB process will be introduced to be used by WAJ in order to reduce operational and maintenance costs and to reduce the generation of biosolids of which about 600,000 tons are piled up to be disposed of or reused by WAJ.

WERSC will lead this activity and other scientist and experts will be invited to join the roundtable seminar as per a proposal that will be submitted by WERSC to accomplish this activity.

IX. Conclusion

The visit to Jordan made by Mr. Robert Freitas, the project director, and Dr. Akrum Tamimi, the project coordinator fulfilled all its objectives.

Dr. Tamimi will visit Jordan again in the second half of September to meet with Mr. Ross Hagan and discuss the updated version of the FY 06-07 SOW and the level of funding that will be available for the activities presented in the Scope of Work. Dr. Tamimi will also follow up on the activities presented in this report to make sure that they are proceeding according to plan.

Appendix B

List of Previous and Future Activities

Sustainable Development of Drylands Project Implemented by IALC Members:

The University of Arizona & Badia Research And Development Center

WAJ's Involvement in the Project

Previous Work

1. Wastewater Treatment and Reuse Study Tour in Southwest US: December 2003
2. Membership in ad hoc committee for biosolids: May 2004
3. Study Tour in Biosolids Analysis and Application in Arizona: May 9 to May 20, 2004
4. Water Demand Management Conference: May 30 to June 3rd at the Dead Sea
5. WEPIA Water Demand Management Course: at JUST – 2004
6. Recycling of Wastewater and Biosolids Workshop: Maximizing Benefits and Safety: Held at NCARTT – June 7 to 10, 2004
7. Characterization of biosolids at 3 WWTP: Wadi Mousa, Wadi Hassan & JUST campus
8. Development of Improved Technology for Biosolids Treatment
9. Modeling Biosolids Treatment at Wadi Hassan
10. Providing Technical Assistance to Modify Jordanian Biosolids Standards: JS 1145/1996 through: Biosolids Risk Assessment and Standards Development Methods: A Workshop and Seminar held at RSS/ERC December 2005
11. Management practices of sludge and biosolids in Jordan: RSS/ERC & biosolids ad hoc committee (ongoing)
12. Anaerobic Low Cost Low Energy Technology for wastewater Treatment Workshop in Egypt

Proposed Work (2006-2007)

13. Required Biosolids Laboratory Training at WAJ labs: RSS/ERC, U of A and BRDC
14. Development of Drying Bed Sludge Treatment Method to Arrive at a Permitted "Process to Further Reduce Pathogens" (PFRP) (Madaba) – U of A and RSS/ERC
15. Application of Treated Biosolids to Land Irrigated with Effluent (Madaba) – RSS/ERC, NCARTT and WAJ

16. Manual for Management of Biosolids in the Drying Beds at the WWTP Level (Volume I) – RSS/ERC and ad hoc committee

17. Management Practices of On-farm Biosolids Application Manual (Volume II) – JUST, RSS/ERC and ad hoc committee

18. Laboratory Procedure Manual (Volume III)

19. Management Aspects of Full Scale UASB Anaerobic Treatment Plant Round Table Seminar