

SUSTAINABLE DEVELOPMENT OF DRY LANDS
IN ASIA AND THE MIDDLE EAST:
JORDAN COMPONENT

Jordan Visit Report
July 9 to July 14, 2006

Report Number
2006-002

Prepared

By

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Appendix A

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I. Introduction

In an attempt to coordinate and facilitate the activities of the Sustainable Development of Dry Lands Project in Jordan (referred to as the project in this report), Dr. Tamimi traveled to Jordan to visit with the Badia Research and Development Center (BRDC) the main partner in the project to discuss the different activities, to visit Jordan University of Science and Technology (JUST) to coordinate and discuss the offering of the video conferencing course, to visit with the University of Jordan's Water and Environmental Research and Studies Center (WERSC) to discuss the anaerobic wastewater treatment proposal comments received from the review panel and discuss the contracting mechanism, to visit with Royal Scientific Society's Environmental Research Center (RSS/ERC) to discuss current activities and future biosolids activities and to visit with Mr. Ross Hagen at USAID Amman Mission to update him on the progress of the activities for this fiscal year and provide a summary of the proposed activities for fiscal year 2006-2007.

II. Objectives of the Visit

Dr. Akrum Tamimi traveled to Jordan on July 9, 2006 to visit the Sustainable Development of Dry Lands Project Jordanian partners and to update the USAID – Amman mission on the status of the project. The Jordanian partners that were planned to be visited are listed below with an outline of the topics to be discussed during the meetings.

1. Badia Research and Development Center (BRDC)
 - a. Review the status of project activities
 - b. Brain storming for 06-07 SOW
 - i. Which Governmental Agencies should we visit?
2. Royal Scientific Society (RSS)
 - a. Installation of Weather Station at Madaba Wastewater Treatment Plant (WWTP)
 - b. Discuss publication papers and monitoring data gathered at Ar Ramtha
 - c. Discuss Fiscal Year 06-07 Scope of Work (SOW)
 - i. Advanced biosolids lab training for RSS and two other Jordanian agencies
 - ii. Basic biosolids lab training at WAJ conducted by RSS and steered by The University of Arizona Technical Assistance Team (TAT) as a joint effort
 - iii. Application of Biosolids for agricultural production – at reduced cost– (if funds available)
 - iv. Modeling biosolids disinfection at Madaba WWTP
 - v. Reuse of biosolids in agricultural crop production irrigated with treated effluent – discuss involving a graduate students
3. Jordan University of Science and Technology (JUST)
 - a. Present package of distance learning course to Dr. Turki, Dean of College of Engineering for discussion.
 - b. Meet with JUST VP and/or president if available
 - c. Discuss the status of the extension work with Dr. Ziad Ghazawi
 - d. Discuss the availability of grad students for research activities in Jordan: modeling, application of biosolids and effluent, anaerobic treatment

4. University of Jordan, Water and Environmental Research and Studies Center (WERSC)
 - a. Discuss anaerobic proposal and go over reviewers comments
 - b. Explain the reply for comments and the contracting process with BRDC
 - c. Discuss supporting graduate students to work on the anaerobic technology
5. Water Authority of Jordan – Ministry of Water and Irrigation (WAJ/MWI)
 - a. Meet with Engr. Saleh Malkawi and Engr. Ahmad Ulaimat and/or Secretary General to:
 - i. discuss the Basic biosolids lab training at WAJ to be conducted by RSS and the TAT as a joint effort
 - ii. Find the status of the biosolids standards
 - iii. Discuss translation of the standards to English by WAJ
 - iv. Discuss future activities at Madaba WWTP
 - b. Meet with Mr. Mohammed Mansour from MWI and update him on anaerobic activities in Jordan
6. United States Agency for International Development (USAID)
 - a. Meet with Mr. Ross Hagen on Thursday July 13, 2006 to:
 - i. Present him with the CD and report of the anaerobic workshop that took place in Egypt.
 - ii. Present him with the CD and report of the Biosolids risk assessment and standards development workshop
 - iii. Update him on the current activities and meetings with Jordanian partners
 - iv. Give a summary of activities that will be included in the FY06-07 SOW for feed back
 - v. Determine the availability of an entry meeting with him while Bob is Jordan for discussing 06-07 SOW (August 12-25, 2006) and an exit meeting to finalize the 06-07 SOW

Please notice that the itinerary of the visit is presented in appendix A of this report.

III. Badia Research and Development Center

On July 9, 2006, Dr. Tamimi had a conference call with Dr. Saad Al-Ayyash since Mr. Shahbaz was taking few days off as personal time.

The discussion involved reviewing Dr. Tamimi's itinerary. Dr. Al-Ayyash indicated that he will be able to attend all the meetings Dr. Tamimi arranged except for the visit to Madaba on Tuesday since he has a prior commitment.

The project activities were discussed and special attention with special attention given to finishing the contracting papers and transfer of funds for a few of the project activities.

IV. Madaba Wastewater Treatment Plant

On Tuesday, July 11, 2006 Dr. Tamimi, Dr. Nisreen Hmoud, microbiologist Shawqi and Mr. Iyad Dusouqi from CMC/RSS – Amman traveled to Madaba, about 30 Km southwest of

Amman. The purpose of the visit was to install the weather station for monitoring the treatment of biosolids in solar dry beds and to collect information related to the treatment plant and to the effluent reuse area.

The weather station components were hauled to the treatment plant the day before by the RSS staff members. At the Wastewater Treatment Plant (WWTP) the team met with the director of the plant:

Engr. Abdel Karim Jarrar, Mechanical Engineer

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Telephone: (W) +962-5-324-4729

(H) +962-6-534-7925

Engr. Abdel Karim indicated that he has been working for Water Authority of Jordan (WAJ) for the last 20+ years.

The first task accomplished was to identify where the weather station would be installed. A location close to a drying bed was recommended by the operators of the plant and the land was leveled by the operators and the station was installed with its wind speed and direction instrument facing north and with the solar panel that charges the battery facing south. The entire station was leveled and the wiring of the sensors were pulled and identified.

It was recommended by one of the operators to have the weather station fenced due to the many people and shepherds who walk the area. This information was related to Engr. Wael Suleiman later after returning to RSS and the fencing was supposed to start the following day.

V. Royal Scientific Society-Environmental Research Center

Dr. Tamimi and Dr. Al-Ayyash met with Dr. Dr. Bassam Hayek and with Engr. Wael Suleiman on July 12, 2006 at RSS/ERC. The discussion revolved around current and future activities that will be financed by the project to RSS/ERC. The current activities and the proposed future ones were discussed in details as shown next.

1) Current Activities

a. Application of Biosolids at Ar-Ramtha

Ar-Ramtha study of applying biosolids to land cropped with rain-fed barley is coming to an end. The crop was harvested and testing of soil and plants is going on at RSS/ERC. The analysis will be completed this summer and a final report will be provided to the project by the end of September 2006.

RSS/ERC is looking forward to a decision by the project to fund a third growing season study to better understand the residual effect of biosolids on the soil. Dr. Tamimi indicated that the funding depends on the availability of funds from USAID.

b. Modeling of Biosolids Treatment

As indicated in heading IV earlier, the weather station was moved to Madaba WWTP and was installed. A SIM card from Fast Link Cell Company needs to be obtained and installed

to be able to dial into the station and get the weather data. It was indicated that this will be accomplished in the coming week. RSS staff indicated that they will start a study at the drying bed before the end of July to obtain a set of data for the summer season.

A proposal was submitted to the project to be peer reviewed. The peer review has not been finished yet and that needs to be completed by the TAT so as to complete the contracting process through BRDC to have the funds transferred from The University of Arizona to RSS/ERC via BRDC.

2) Proposed Activities

The following activities are proposed for FY 2006-2007 and are dependant on funds availability. No funds have been secured yet but it is expected that the level of funding from the mission side will match last year's funding.

a. Advanced Biosolids Lab Training in Arizona

In response to RSS/ERC request to assist in training microbiologist in the area of microbiology especially in the area of testing viruses to enforce the JS: 1145/2006 standards; the project has been developing plans to accommodate that request. It is suggested here from what was gathered during this trip to train 2 lab personnel from RSS/ERC, 2 from WAJ, and one from Ministry of Health. The concentration in the training would be on testing viruses.

It has been suggested that the participants depart Amman to Tucson on Saturday October 28, 2006 and have 3 weeks of training ending on Friday November 17. The participants would depart from Tucson to Amman on Saturday November 18, 2006.

It was discussed with Dr. Saad Al-Ayyash from BRDC to work with IALC on developing an invitation letter to the participants to start the process of obtaining a visa from the Visa Section of the US Embassy in Amman.

b. Required Biosolids Lab Training

The JS: 1145/2006 standard requires testing of biosolids parameters. Water Authority of Jordan, being the enforcing agency, is required to have the expertise in testing the different parameters mentioned in the standards. Sufficient expertise at WAJ is not available to monitor the reuse of biosolids. In addition, USAID – Amman Mission is working closely with WAJ/MWI to have their laboratories certified for laboratory testing in the areas of water and wastewater.

Through this activity, it is proposed to have RSS/ERC conduct the hands-on laboratory training program at WAJ laboratories. This activity will be led by RSS/ERC and assisted by Dr. Chuck Gerba and his microbiology lab staff in addition to members from the TAT at the U of A. Laboratory technicians from other Jordanian partnering institutions will be invited as participants in the training depending on the availability of lab space.

The number of trainees that will be invited to participate will not exceed 12 since the labs where the training will take place will not accommodate more than 12 persons. RSS/ERC will conduct an evaluation of the WAJ labs to determine which tests can be completed at WAJ and which ones have to be done at RSS/ERC labs. A proposal will be developed by RSS/ERC detailing the training content to be evaluated by Dr. Gerba's lab at The University of Arizona.

VI. Jordan University of Science and Technology (JUST)

As indicated in the itinerary shown in appendix A, Dr. Tamimi and Dr. Al-Ayyash met with Dr. Turki Obaidat, the dean of the College of Engineering at JUST. Dr. Tamimi presented the document shown in appendix B for discussion.

Dr. Obaidat had few issues with the proposal and these can be summarized as follows:

- 1) For Jordan Government Agencies participants, JUST will not be able to have the participants register for credit at JUST since they have not been accepted as graduate students in the program. However, Dr. Turki indicated that the participants can register for an audit but they would receive no credit to be carried on for future use if they become interested in the graduate program and they get accepted in the future. Dr. Turki also indicated that The University of Arizona will not be able to give credit to the participants since the course will be offered by JUST. Dr. Turki accepted after a long discussion that he would offer a certificate of participation to be designed by Dr. Tamimi and approved by Dr. Turki indicating that the participant had completed the course in reclaimed water irrigation management without mentioning any hours or credits. The designed certificate would have both JUST and The University of Arizona logos and be signed by Dr. Turki and a representative of the project or The University of Arizona.
- 2) In regard for the time of the course, it was indicated by Dr. Turki that it will be better if the course is offered in the afternoon, specifically from 4:00 p.m. to 5:15 p.m. since most of the graduate courses and the lab sessions are scheduled for that time. It was indicated by Dr. Al-Ayyash that this timing will be better since none of the students will be able to make it to class by 8:00 a.m. as originally proposed especially participants from the governmental agencies. Dr. Tamimi indicated that will be a little better for The University of Arizona staff since they don't have to stay teaching after midnight. Dr. Tamimi sent an email to The University of Arizona staff who will be involved in teaching the class and they accepted the new time. However, Mr. Bob Freitas, the project director of the Sustainable Development of Dry Lands Project, showed concerns regarding the lectures during Ramadan since most students and participants will be very tired and ready to go home for breakfast after fasting at that time. The team from JUST and the University of Arizona are encouraged to give ideas on how to handle this issue. In addition Mr. Freitas indicated that the statements contained in the course proposal submitted by Dr. Tamimi regarding future cooperation between JUST and The University of Arizona in new courses utilizing video conferencing technology are conditional on the success of this proposed course and on the availability of funding.
- 3) Regarding the coordinator of the course, Dr. Turki indicated that the person who will be coordinating the class will be given that course as part of the teaching load at the department and he/she will be responsible for all course related issues as given in the proposal presented in appendix B.

After two hours of discussions between Dr. Akrum, Dr. Turki and Dr. Al-Ayyash, it was agreed that Dr. Tamimi prepares a letter and a modified proposal explaining the purpose of

the course and what is requested from JUST. Dr. Turki then would take that document and proposal and give it to the Water Group at JUST Civil Engineering department. The water group will be requested to name persons for coordinating the course and for teaching the portions of the class that are assigned for JUST as indicated in the document.

Dr. Tamimi modified the proposal taking into considerations Dr. Turki's concerns with an email message indicating what is requested from JUST. This information is presented in appendix C of this document.

VII. Water Authority of Jordan (WAJ)

As indicated in the visit itinerary presented in appendix A of this report, Dr. Tamimi and Dr. Al-Ayyash visited WAJ on July 12, 2006 @ 11:00 am. Present in the meeting were: Engr. Ahmad Ulimat and Engr. Saleh Malkawi from WAJ reuse unit. The following items were discussed during the meeting:

1) Meeting with the Secretary General in August

During the meeting, Dr. Tamimi requested a future meeting with WAJ secretary general when project director Mr. Bob Freitas visits Jordan in August. Dr. Tamimi indicated that the objective of the visit is to give a presentation of the past and proposed future activities that touches WAJ directly or indirectly. Engr. Ulimat welcomed the idea and indicated that he will facilitate a meeting as soon as he hears about the dates and the times from Dr. Tamimi.

2) Required Lab Training in Jordan

The required lab training discussed with RSS/ERC was presented at the meeting and Engr. Malkawi indicated that it will be good if four lab technicians from WAJ are present in the training to make sure that WAJ will have the capability to test for viruses in biosolids as required by the JS: 1145/2006. It was indicated by Engr. Malkawi that it is a good idea to have the training at WAJ. He requested a lab evaluation be done by RSS & WAJ to determine the missing equipment at the WAJ labs so can get to work on getting the missing equipment from other funding sources.

3) JS: 1145/2006 Standard

It was indicated by Engr. Malkawi that the final version of the biosolids standards JS: 1145/2006 has been approved by JISM and will be published in the official newsletter in about two months. Translation of the standard into English has been proposed by WAJ to JISM to arrive at a final official English version of the standard. JISM indicated that they will be able to provide the translation.

4) Proposed Activities at Madaba WWTP

Dr. Tamimi gave a brief explanation of the modeling activity being conducted at Madaba WWTP and the installation of the weather station and presented future proposed activities that might get implemented at the same site. The activities Dr. Tamimi mentioned are:

1. Reusing of treated effluent and application of biosolids to grow forage.
2. Using a hybrid system for low cost treatment process that utilizes UASB technology.
3. Developing guidelines to arrive at Type I biosolids using solar drying beds.

Both WAJ staff members welcomed the activities and Engr. Malkawi indicated that he will be able to provide a field area for activity 1. It was also suggested that Dr. Tamimi make a presentation at the biosolids ad hoc committee meeting of the characterization paper he developed and of the modeling of biosolids treatment. He also indicated that a statistical methods and experimental design course might help the staff at WAJ who deal with laboratory reports and application studies. Dr. Tamimi indicated that such a course is in the planning and will probably be offered next year pending sufficient funds available.

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

On July 13, Dr. Tamimi visited WERSC and met with Dr. Manar Fayyad and Dr. Maha Halalsheh. The comments from the peer reviewed proposal were discussed. Dr. Halalsheh felt fine with the comments and thought that they are acceptable and she will be able to respond to them and adjust her proposal and research study in a week or 10 days.

Dr. Tamimi described the mechanism that WERSC has to follow with BRDC to have the contract signed so the funds can be transferred to WERSC. Dr. Halalsheh indicated that she will work with Dr. Saad Al-Ayyash from BRDC to get things rolling to start the work.

IX. United States Agency for International Development, USAID

Dr. Tamimi met with Mr. Ross Hagan from USAID on July 13, 2006. He briefed Ross on his visit to Jordan and gave a brief description about the proposed Scope of Work being developed from FY 2006-2007. The activities discussed with the different Jordanian agencies as outlined above were presented. Mr. Hagan was receptive to the proposed activities. He asked about the status of the new biosolids standards and Dr. Tamimi indicated that they have been approved and are in the process of being finalized to be published in the official newspaper.

Dr. Tamimi requested appointments for entry and exit meetings for project director, Mr. Bob Freitas visit to Jordan coming up starting August 12, 2006. August 14, 2006 at 9:00am was set for an entry meeting and August 23, 2006 at 9:00am was set for an exit meeting.

Dr. Tamimi provided Mr. Hagan with 3 CDs: one for the 2004-2005 project reports, the second was for the biosolids risk assessment workshop held in December 2005 and the third was for the Egypt anaerobic wastewater treatment workshop held during March 2006. Dr. Tamimi indicated that these CDs are the final versions and promised Mr. Hagen with official ones with proper labels and logos.

X. Conclusion

The trip to Jordan made by Dr. Tamimi was a success. Dr. Tamimi fulfilled all projected objectives from the visit and met with all concerned project partner.

**Draft of Distance Learning Proposal
For
Discussions Purposes**

Distance Learning Course

The University of Arizona and Jordan University Of Science and Technology

Reclaimed Water Irrigation Management

I. Course Information and Logistics

1. The course will be offered in the fall of 2006 which starts the first week of October, 2006. Marketing the course by Jordan University of Science and Technology (JUST) will take place starting July 2006 and listing of the course in JUST course offering will be completed in July.
2. The course will be offered under the faculty of engineering – department of civil engineering listing as CE785: Special Topics for master students at JUST and for other participants from Governmental organizations and agencies.
3. Invitation letters to participate in the course will be sent by Badia Research and Development Center (BRDC) to Jordanian Partners in the Sustainable Development of Dry Lands Project. These will include but not limited to: BRDC, Water Authority of Jordan (WAJ), Ministry of Water and Irrigation (MWI), Ministry of Agriculture (MOA), Ministry of Environment (MOE), Royal Scientific Society (RSS), Aqaba Special Economic Zone Authority (ASEZA), United States Agency for International Development (USAID), National Center for Agricultural Research and Technology Transfer (NCARTT), Jordan Institute for Standards and Metrology (JISM), Jordan Valley Authority (JVA). The invitation letter will include most materials contained in this proposal. At least one member from each organization will be able to register for master credit or for master audit and JUST will waive the fees for participants from these governmental agencies.
4. A maximum number of 10 JUST students and a maximum number of 10 participants from governmental agencies will be able to register in the course.
5. The course will be offered every Tuesday and Thursday starting at 8:00am (Jordan Time) and will run for one hour and 15 minutes (1:15).
6. The Course will be delivered using the video conferencing capabilities available at JUST and The University of Arizona and other electronic medium for back up purposes.

7. A coordinator from the college of engineering will be named as the coordinator for the course. The coordinator of the course will be responsible for the course and will take care of attendance, reviewing policy and regulations, approving grades and evaluation and corresponding with the faculty at The University of Arizona. In addition, the coordinator will be present during each lecture to facilitate technical problems and to clarify questions and issues related to communication, content or questions that rise from language difficulties, if any. Both JUST and the Sustainable Development of Dry Lands Project will review the credentials of the coordinator and will confer on the naming of JUST faculty member.
8. Faculty members from JUST will be named by the Faculty of Engineering to teach the portions of the course indicated in the syllabus as JUST Faculty members (TBD).
9. This course will be the first in many to come courses. This course will be taught jointly this fall as indicated in the syllabus presented later in this document. In the next course more involvement of JUST faculty will be planned and encouraged and it will be desired to have the third future course co-listed at both JUST and The University of Arizona course offerings.

II. Course Description

To be worked out and developed by JUST participating members and The University of Arizona teaching professors.

III. Course Syllabus

Soils, plants, and sodicity	3 lectures	Pete Waller (PW)
<ol style="list-style-type: none">1. Soil chemistry in saline soils2. Plant response to salinity - osmotic and capillary potential3. Nitrogen and phosphorous in soils		
Soil salinity, spatial variation, yield, and economics	3 lectures	PW
<ol style="list-style-type: none">1. Spatial variation of infiltration due to soils2. Spatial variation of infiltration due to irrigation systems3. Relationship between salinity and yield4. Random number generation in Excel5. Generation of expected water application distribution in Excel (normal dist.)6. Calculation of yield distribution in field7. Optimization of irrigation system with respect to cost of water, soil salinity and value of yield.		
Tipping bucket model	3 lectures	PW
<ol style="list-style-type: none">1. Field capacity and permanent wilting point2. Conservation of mass equation - water3. Infiltration and drainage – water4. Dividing soils into cells - water5. Examples of the model – water6. Salinity concentration in water		

7. Conservation of mass equation – salinity
8. Infiltration and leaching – salts
9. Examples of the model - salts
10. High water table (no leaching)

Reclaimed water characteristics **1 lecture** **PW**

1. Pathogens
 - A. Types
 - B. Mode of disease transmission through water
 - C. Disinfectants
 - D. Immune system and immunization
 - E. Risk assessment
2. Nutrients
3. Biological oxygen demand
4. Suspended solids
5. Color and odor
6. Salts
7. Trace contaminants
 - A. Carcinogens
 - B. Heavy metals
 - C. Solvents
 - D. Endocrine Disrupting Chemicals (EDC's)
8. Gray water characteristics and regulations

Wastewater treatment methods and water quality **2 lecture**
Muluneh Yitayew (MY)

1. Primary settling
2. Anaerobic treatment
3. Activated sludge
4. Wetlands and alternative treatment systems
5. Soil disposal and soil aquifer treatment (SAT)
6. Chlorination and other disinfectants
7. Tertiary treatment - filtration and granular activated carbon
8. Nitrogen and phosphorous removal
9. Degradation in surface waters (rivers and reservoirs).
10. Gray water system

Irrigation water quality criteria and monitoring **2 lecture** **MY**

1. Soil sodicity – dispersion, reclamation
2. Water salinity and sodicity
3. Wastewater sampling
4. Water Analysis
 - A. Types of measurements, TDS, SAR, ions, biological
 - B. Use of surrogates
 - C. Use of indicators
5. Water quality evaluation and standards development
6. Communicating water quality to the public and regulators

Site evaluation **1 lecture** **MY**

1. Soils

- A. Texture
- B. Sodidity
- C. Salinity
- 2. Proximity to groundwater, surface water, and humans
- 3. Existing infrastructure and irrigation system
- 4. Other water sources (blending?)
- 5. Level of management expertise onsite
- 6. Effect of vegetation and wastewater solids content on infiltration

Water budget and water management	2 lectures	MY
<ul style="list-style-type: none"> 1. Crop options for high salinity agriculture 2. Reclamation of saline soils with treated wastewater 3. Irrigation with high sodium/low salinity waters 4. Crop evapotranspiration 5. Rainfall 6. Leaching, leaching fraction 7. Dilution 8. Water management for salinity control 9. Calculation of depth of pond (reclaimed water) to be applied to manage salinity. 10. Calculation of volume of pond water to be applied. 11. Salinity management 		

Irrigation system design	4 lectures	MY
<ul style="list-style-type: none"> 1. Land area and storage requirements 2. Irrigation requirements and scheduling 3. Irrigation application rate and depth <ul style="list-style-type: none"> A. As a function of solids content B. As a function of soil texture C. As a function of depth to water table 4. Drip design 5. Bubbler design 6. System design <ul style="list-style-type: none"> A. Pipes B. Pumps C. Zones D. Surface irrigation systems 		

Case studies from Jordan (lectures given by JUST faculty member(s))

Effluent production and levels of treatment	2 lectures	TBD
Quality characterization of reclaimed water	1 lectures	TBD
Standards and criteria for reuse	1 lectures	TBD
Environmental and health impacts	2 lectures	TBD
Salinity impacts on Jordan Valley and On the Gulf of Aqaba	2 lectures	TBD

Appendix C

Distance Learning Syllabus And Other Issues

Contents of the email message dated July 13, 2006:

Dear Dr. Turki,

Thank you very much for receiving me and Dr. Saad Al-Ayyash from BRDC on Monday July 10, 2006 and spending your precious time with us to discuss the distance learning course.

As you requested, you find attached the course proposal in a new format. The proposal is comprise of the following sections:

- **Course Information and Logistics**
- **Course Description**
- **Course Syllabus**
- **What is Requested From JUST**

The first section has been modified to reflect the omission of wordings that you did not feel comfortable with. These specific areas will be presented clearly in the minutes of the meeting I am compiling to be sent to you. The minutes will reflect the different options we discussed to handle the omitted wordings and issues.

The second section will wait to be acted upon by JUST faculty members (or by the group of JUST faculty members that will be chosen from within the Civil Engineering Department) and The University of Arizona faculty members.

The third section has been modified to reflect correctly the numbering of the sections and subsections of the course materials.

The third section has items that JUST have to act upon as soon as possible.

I would like to emphasize that you are going to give the attached document to the Civil Engineering (CE) Department so that it can be discussed internally within the CE department and a decision from the CE department will be sent to you with an action plan and names of faculty members who will be involved in this course.

Again, I would like to thank you for your cooperation and allowing this pioneering course idea to start on the right foot.

Best regards,

Akrum

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Distance Learning Course

The University of Arizona and Jordan University Of Science and Technology

Reclaimed Water Irrigation Management

I. Course Information and Logistics

1. The course will be offered in the fall of 2006 which starts the first week of October, 2006.
2. The course will be offered under the faculty of engineering – department of civil engineering listing as CE785: Special Topics for master students at JUST and for other participants from Governmental organizations and agencies.
3. A maximum number of 10 JUST students and a maximum number of 10 participants from governmental agencies will be able to register in the course.
4. The course will be offered every Tuesday and Thursday starting at 4:00pm (Jordan Time) and will run for one hour and 15 minutes (1:15).
5. The Course will be delivered using the video conferencing capabilities available at JUST and The University of Arizona and other electronic medium for back up purposes.
6. This course will be the first in many courses to come. This course will be taught jointly this fall as indicated in the syllabus presented later in this document. In the next course more involvement of JUST faculty will be planned and encouraged and it will be desired to have the third future course co-listed at both JUST and The University of Arizona course offerings.

II. Course Description

To be worked out and developed by JUST participating members and The University of Arizona teaching professors.

III. Course Syllabus

Soils, plants, and sodicity	3 lectures	Pete Waller (PW)
<ol style="list-style-type: none">1. Soil chemistry in saline soils2. Plant response to salinity - osmotic and capillary potential3. Nitrogen and phosphorous in soils		
Soil salinity, spatial variation, yield, and economics	3 lectures	PW
<ol style="list-style-type: none">1. Spatial variation of infiltration due to soils2. Spatial variation of infiltration due to irrigation systems		

3. Relationship between salinity and yield
4. Random number generation in Excel
5. Generation of expected water application distribution in Excel (normal dist.)
6. Calculation of yield distribution in field
7. Optimization of irrigation system with respect to cost of water, soil salinity and value of yield.

Tipping bucket model

3 lectures

PW

1. Field capacity and permanent wilting point
2. Conservation of mass equation - water
3. Infiltration and drainage – water
4. Dividing soils into cells - water
5. Examples of the model – water
6. Salinity concentration in water
7. Conservation of mass equation – salinity
8. Infiltration and leaching – salts
9. Examples of the model - salts
10. High water table (no leaching)

Reclaimed water characteristics

1 lecture

PW

1. Pathogens
 - A. Types
 - B. Mode of disease transmission through water
 - C. Disinfectants
 - D. Immune system and immunization
 - E. Risk assessment
2. Nutrients
3. Biological oxygen demand
4. Suspended solids
5. Color and odor
6. Salts
7. Trace contaminants
 - A. Carcinogens
 - B. Heavy metals
 - C. Solvents
 - D. Endocrine Disrupting Chemicals (EDC's)
8. Gray water characteristics and regulations

Wastewater treatment methods and water quality

2 lecture

Muluneh Yitayew (MY)

1. Primary settling
2. Anaerobic treatment
3. Activated sludge
4. Wetlands and alternative treatment systems
5. Soil disposal and soil aquifer treatment (SAT)
6. Chlorination and other disinfectants
7. Tertiary treatment - filtration and granular activated carbon
8. Nitrogen and phosphorous removal
9. Degradation in surface waters (rivers and reservoirs).
10. Gray water system

Case studies from Jordan (lectures given by JUST faculty member(s))

Effluent production and levels of treatment	2 lectures	TBD
Quality characterization of reclaimed water	1 lectures	TBD
Standards and criteria for reuse	1 lectures	TBD
Environmental and health impacts	2 lectures	TBD
Salinity impacts on Jordan Valley and On the Gulf of Aqaba	2 lectures	TBD

IV. What Is Requested From JUST

1. Name a course coordinator from the college of engineering. The coordinator of the course will be responsible for the course and will take care of attendance, reviewing policy and regulations, approving grades and evaluation and corresponding with the faculty at The University of Arizona. In addition, the coordinator will be present during each lecture to facilitate technical problems and to clarify questions and issues related to communication, content or questions that rise from language difficulties, if any.
2. Determine who from the master's students registering in the different Master's programs at JUST will be able to register for the course to receive credit.
3. Market the course by Jordan University of Science and Technology (JUST) as soon as possible and have the course listed in JUST's course offering as soon as possible.
4. Decide on who from the College of Engineering will be responsible for teaching the portions of the syllabus that will be taught by JUST faculty members.
5. Develop the portion of the syllabus that JUST faculty members will be teaching.
6. Have JUST faculty members who will be involved in this course jointly work with The University of Arizona faculty members to develop the course description.