



## CityLinks Jordan Final Report

Jordan University of Science & Technology – Ministry of Health –  
East Carolina University, North Carolina

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## Background

The Hashemite Kingdom of Jordan is located in the Middle East between Syria to the north, Iraq and Saudi Arabia to the east, and the West Bank and Israel to the west. Jordan's population was 5.4 million in 2004, with an average growth rate of 3.1 percent. The country has a total area of 92,300 square kilometers. Its climate is mostly arid desert with a rainy season in the west from November through April. The country suffers from droughts and limited natural fresh water resources. Thus, the protection of water resources is a priority issue.

Medical care is another priority in Jordan. In addition to Jordan's 98 public and private hospitals, there are an estimated 645 healthcare centers and rural clinics in operation. The country has recently witnessed a rapid growth in medical care facilities in both the public and private sectors. In 1995, there were 7,440 beds in public and private hospitals; by 2002, this number had increased to about 10,000. This growth has had the positive effect of creating reputation for Jordan as the leading country for advanced healthcare systems and services in the Middle East. This growth has also created challenges.

Primary among the challenges stemming from the rapid growth of healthcare facilities is the need to manage an ever-increasing amount of medical waste. Jordan's hospitals generate an estimated 9.4 tons a day. Almost all of the hospitals, laboratories, and other medical facilities in Jordan discharge mixed domestic and medical waste, including liquid waste that is poured into the sanitary sewer system, often without notice to the treatment facility. Medical waste is dangerous. Some medical waste is infectious, while other waste contains hazardous sharps (used needles) and chemical or radiological materials. Improper treatment of medical waste can result in the contamination of water and can spread infection and disease to waste handlers and/or the public.

Given these risks, the United States Agency for International Development (USAID) funded a CityLinks Project to assist Jordan in improving its management of medical waste in an effort to protect drinking water resources and public health and to help prevent general environmental degradation. At the time Jordan University of Science and Technology (JUST) was interested in finding a solution to overcome the increasing challenges posed by medical waste. What they crafted was a proposal to use their two incinerators, which were capable of burning medical waste, as part of a strategy to centralize the collection and disposal of medical waste in the northern region. JUST worked closely with the Ministry of Health (MoH), the government agency charged with medical waste oversight, to gain their buy-in and full collaboration in implementing the strategy. USAID in agreeing to the JUST/MoH proposal chose the CityLinks program in an effort to bring U.S. experience, expertise, and assistance to bear on the implementation of the JUST/MoH solution for the northern region. ICMA played the critical role of managing the effort, ensuring that project objectives were met in a timely fashion and within the specified budget. The result: a more effective medical waste management system in northern Jordan

Recognizing the importance of having a U.S. counterpart that understood the medical waste management from generation to final disposal, ICMA chose East Carolina University (ECU). In the United States, regulatory changes governing the operation of medical waste incineration have caused the vast majority of hospitals to discontinue operation of their own incinerators and to contract out medical waste disposal services. ICMA research found just 13 U.S. hospitals that currently own and operate an incinerator to burn medical waste. Of these, only a few are affiliated with a university system.

ECU was among the few universities that owns and operates an incinerator of medical waste. Part of the University of North Carolina, ECU also partners closely with Pitt County Hospital, a teaching hospital affiliated with its medical school. ECU's practical experience with the incineration of medical waste, comparatively similar characteristics to JUST, and strong relationships with regulators made it a good choice for the U.S. partner organization.

## **The Problem**

The first step in the CityLinks process is to conduct an analysis of the problem, which later serves as the basis for the development of the project objectives. In collaboration with JUST and the MoH, ICMA and ECU conducted some initial research. This preliminary work included touring hospitals in the northern region of Jordan and reviewing the JUST incinerators. Based on this research, the program partners found several problems with Jordan's waste management, including:

- **Lack of consistent management policies and practices in hospitals.** Management policies and practices either did not exist or were unknown by nurses, housekeepers, and other hospital staff. Some hospitals that had formal policies failed to widely disseminate them. Hospitals that did communicate policies did so on a sporadic basis; in some cases, policies were shared during initial employee orientation but were never referred to after that. The resulting lack of awareness was often reflected in the inability of hospital staff to effectively separate medical and domestic waste, properly dispose of sharps, and/or know what to do if a hazardous spill occurs. Hospitals also lacked signage or other written information to remind staff of waste management policies and direct them in effective waste management practices.
- **Lack of appropriate equipment and products.** In general, hospitals lacked the equipment needed to safely dispose of waste. For example, at the vast majority of the hospitals that ICMA and ECU visited lacked suitable containers for sharps. In some hospitals, personnel compensated by using plastic bottles with wide, open tops and penetrable sides to dispose of sharps, but this procedure raised other safety concerns—namely, it increased the risk that the used needles would puncture the skin of staff handling the containers and spread contamination. The quality of the plastic bags used for other types of medical waste was another problem: In many cases, the bags were too easily punctured and the resulting leaks caused a substantial health hazard. (Hospital administrators recognized the need for better bags but indicated that vendors were unable to provide them.) Moreover, there was no consistency in what colors were used for medical waste: Some hospitals used red bags, while others

used yellow. Still others had no set color for medical waste and used whatever bags were available. This increased the risk that handlers and others would fail to recognize medical waste and handle it with the caution it required. Further, it also increases the risk that medical waste would be considered domestic waste, which could result in infectious waste being put in landfills, increasing the risk of drinking water contamination.

- **Lack of awareness of MoH regulations.** Hospital administrators noted that they lacked clarity about MoH regulations, citing the various colors used for bags as an example of some of the difficulty and ambiguity associated with the regulations. It became apparent that there was a need for regulatory outreach on the part of MoH to ensure hospitals and other facilities were aware of the regulations and understood them sufficiently.
- **Lack of efficiently operating incinerators at hospitals.** Most of the hospitals visited by ICMA and ECU operated their own incinerators. The incinerators emitted black smoke that clearly indicated a malfunction. The smoke was polluting the air and served as a warning that the medical waste was probably not being combusted properly, resulting in two public health and environmental challenges.
- **Lack of proper external storage.** At many hospitals, the storage facilities for medical waste were in deplorable condition. Some simply lacked adequate space to store waste; others lacked running water or had leaks in the roof. Perhaps most troubling were instances in which inadequate drainage and leaky floors resulted in the contents of the leaky bags to ooze out onto city streets.

The preliminary research undertaken by ICMA and ECU confirmed JUST's opinion that its incinerators, which had been used only sparingly since the late 1980s, could be used, if they were upgraded to meet quality standards. Review indicated that the incinerators had sufficient capacity to meet the needs of all the hospitals in northern Jordan and perhaps the entire country. The incinerators had been upgraded in 2000 to meet MoH regulations for processing medical waste and were the most effective and efficient incinerators in the country for burning medical waste.

JUST's location in a rural area away from an urban center made it an ideal setting for incinerating waste. Located several kilometers outside the city limits of Irbid, the university's campus is one of the largest in the world. The specific site of the incinerator facility keeps emissions away from students and residents of Irbid.

Assistance would be needed to capitalize on this resource, however. The JUST incinerators were found to be noncompliant with the new regulations that MoH issued in 2001.

## **Response: CityLinks Partnership for Medical Waste Management**

To meet the challenges noted above, a project team consisting of representatives from JUST, MoH, ECU, and ICMA met to develop an action plan aimed at improving

medical waste management in Jordan. The Medical Waste Management Project of Northern Jordan (MWMPNJ) focused on the northern region of Jordan primarily because this region had available incinerators. The team believed that focusing initially on a manageable geographic region would increase the chance of success.

At its first set of meetings, the project team scoped out the following objectives and deliverables:

- Describe and assess the current medical waste management practices in northern Jordan. *Deliverable:* A study/report that describes the status and challenges of the medical waste management in the northern region.
- Enhance the efficiency and effectiveness of the medical waste management system at JUST. *Deliverables:* Study, recommendations, and an implementation of a centralized collection and disposal system.
- Enhance the management capacity of the medical waste management staff in the northern region of Jordan. *Deliverables:* Develop and provide training and support materials to key staff in hospitals including, administrators, doctors and nurses supervisors, housekeeping and internal waste collectors, and incinerators and external waste collection operators.
- Conduct analysis of waste composition and generation rates of medial waste in northern Jordan hospitals. *Deliverables:* A study that provides analysis of the composition and generation rates of medical waste generated in northern Jordan.
- Determine the feasibility and potential strategies for public-private partnerships pertaining to medical waste management in Jordan. *Deliverable:* A report that identifies areas for private sector participation and strategies that could be implemented to increase private participation in medical waste management in Jordan.
- Review current regulatory framework and provide recommendations to change or improve the national regulatory framework. *Deliverable:* A report listing the challenges and recommendations for improving the medical waste national regulatory framework.

After agreeing on these objectives, the project team developed specific tasks and subtasks along with timeframes in which they should be accomplished.

## **Activities and Accomplishments**

Under the auspices of the CityLinks program, the MWMPNJ made great strides in developing and implementing practical solutions to Jordan's waste management problems. The improvements made have already improved the protection of the country's water resources and implemented better safeguards for public health.

The MWMPNJ's accomplishments include:

- **New centralized collection and disposal of medical waste.** Launched in September 2005, the collection and disposal of medical waste service was a culmination of significant work on behalf of the project team to develop and implement a system that serves all 21 public hospitals in the northern region, as well as other private facilities. Each partner played a critical role in building this new system: ICMA procured 2 medical waste collection vehicles and 20 waste bins; JUST, with the assistance of ECU, developed a waste transportation scheme and administrative tracking system; JUST also manufactured 20 additional waste bins to serve all the hospitals and upgraded the appearance of the incinerator facility.

The collection service has provided immediate benefits to the environment and public health by eliminating the need for hospitals to rely on malfunctioning incinerators. Prior to this project, JUST incinerated an average of approximately a half ton of medical waste incinerated per day; this rate has increased to about 1.3 to 1.5 tons per day and is expected to increase in the coming future. Seven incinerators have been closed as a result of the centralized collection procedures, decreasing air pollution and other hazards in Jordan's northern region. The collection and transportation of medical waste by the MWMPNJ services also removes from the roadways other vehicles involved in medical waste disposal, significantly decreasing illegal dumping and accidental spills—and the public health risks that these pose.

- **Improved medical waste management facilities.** As part of its in-kind contributions to the MWMPNJ, JUST has improved its facilities and undertaken other activities that now enable it to properly administer the medical waste collection and treatment services. These improvements and preparation activities include the creation of a new area to clean medical waste bins in the building that houses the incinerators; the production of 20 additional waste bins (created by JUST's industrial design department); the development of a medical waste tracking system; refrigerated storage; and provision and training of incinerator operators.
- **MoH/JUST agreement.** MoH signed an agreement with JUST to pay the university \$100,000JD to collect and treat medical waste from 21 hospitals in the northern region. MWMPNJ's procurement of medical waste transport vehicles and carts, improvements to JUST's facilities, and promise to upgrade its incinerators contributed to MoH's confidence to sign this agreement with JUST.
- **Medical waste management training.** MWMPNJ conducted training for hospital staff on improving medical waste segregation and overall waste management. Led by JUST, the project team conducted four training sessions that targeted different groups involved in medical waste management in hospitals. The first training session targeted hospital administrators and espoused importance of medical waste management, including safety, financial savings, regulatory requirements, and environmental impacts. Doctors and nurses were the audiences for the second training program, which focused on best management practices, emergency procedures, and legal requirements. The training also delineated the link

between management practices and lower waste costs as part of the effort to encourage adherence to management practices. The final two training programs focused on raising the awareness of proper medical waste management among supervisors of the housekeeping staff and operators of incinerators and collection vehicles. This training focused on best management practices for waste separation, emergency response, waste collection procedures, incinerator feeding procedures, and incinerator operation policies and procedures.

ECU was particularly instrumental in developing training approaches and materials that would meet Jordan's needs. The training manuals used at Pitt County Hospital were adapted for use in Jordan. The project team's assistance was critical in ensuring that the training programs in Jordan covered the appropriate subject areas in the right way.

- **Studies and reports.** The project team conducted several studies to learn about the amount and characteristics of the waste generated by hospitals and healthcare facilities in northern Jordan, current management practices, medical waste management challenges, and capacity-building needs of hospital staff. JUST led the research effort in collaboration with MoH; ECU and ICMA played an advisory role in reviewing the survey design and methods and made recommendations to ensure the validity of the studies. The project team compiled survey results and corresponding information in a final report (to be completed in February 2006).
- **Swiss government commitment.** In recognition of the success and momentum created by MWMPNJ, the Swiss government has agreed to provide financial support for the upgrade of JUST's incinerators to fully meet MoH regulatory requirements for burning medical waste. The upgrade will include the following:
  - Increase the temperature of the primary chamber to 800–900°C;
  - Increase the temperature in the second chamber from 1,150°C to 1,200°C;
  - Raise the residence time in the second chamber to two seconds;
  - Install a flue gas cleaning system (e.g. wet scrubber, electrostatic precipitator, bags, etc.).

The cost of the upgrade to JUST's incinerators is estimated at \$864,000 USD; the flue gas cleaning system alone will cost an estimated \$589,000 USD. (The Swiss government is a natural partner in the medical waste effort in the northern region because Hoval, a Swiss firm, is the manufacturer of JUST's incinerators.)

- **Raised awareness of medical waste problems.** Medical waste management was of concern prior to the start of the MWMPNJ; however, the success of the project has helped to raise awareness of the medical community and the general public regarding the dangers of this waste. Donor governments—including the United States (USAID), Switzerland, and others—joined together to form a committee that worked



with the Jordanian government to explore the problem of medical waste management throughout Jordan.

The project accomplished far more than meeting the objectives developed at the outset. The effort has been instrumental in the creating momentum among the government of Jordan, the donor community, the healthcare sector, and others to find solutions to combat the risks posed by medical waste. Attention has broadened beyond northern Jordan to include finding medical waste solutions for the central and southern regions of Jordan. Based on the success of MWMPNJ, the authorities have designated the northern region a model for other regions, which has opened the door for the project team to continue its work beyond the current accomplishments of the MWMPNJ to a possible Phase 2 project.

### **The CityLinks Model: ECU's Contributions**

The selection of ECU as a partner was a critical element in the success of the MWMPNJ. Specifically, ECU provided advice and consultation, technical information and resources, real-life hospital operations observations, and opportunities for discussions with hospital staff, administrators, and regulatory officials.

Specific examples of ECU's contributions in support of the accomplishments of the project include:

- **Incineration upgrade review.** David Lancaster, ECU's representative on the MWMPNJ project, examined JUST's incinerators in Irbid to determine the scope of the upgrades needed to meet MoH requirements and to develop cost estimates. Lancaster is an engineer whose responsibilities include the management of incinerator design and operations projects in ECU's Environmental Health and Safety Division. During the first exchange in the U.S., ECU convened a discussion on upgrade of the JUST incinerator. David Lancaster cautioned that any set of upgrades that included the installation of a flue gas cleaning system, such as a wet scrubber or electrostatic precipitator, would be expensive—perhaps costing well over \$1 million considering the procurement for two incinerators. If the installation of a flue gas cleaning system was needed, ECU recommended that the upgrade be compared to the costs and benefits of the procurement of one or more new incinerators as well as to other disposal options. ECU also recommended that JUST focus its upgrades to ensure that the incinerators would meet appropriate emission guidelines and would attain the temperature levels needed for proper incineration of the medical waste.
- **Technical training materials.** ECU, through consultations and the use of their own training materials as models, assisted JUST in the development of training manuals provided participants at the four training programs that took place on JUST's campus during the project period. The training manuals and subsequent training sessions focused particular attention on infection control, targeting medical waste generators, waste handlers, and incinerator operators.

- **U.S. hospital and incinerator tours.** ECU coordinated tours of Pitt County Hospital and both ECU's and the National Institutes of Health's incinerators for the Jordanian project team. The hospital tour provided the participants with an opportunity to see efficient and safe medical waste handling in a real setting. The tour and discussion included a review of policies and procedures associated with medical and domestic waste separation (Pitt County used just two colors: red for medical waste and white for domestic or municipal waste), infection control measures, emergency response to waste or chemical spills, sharps disposal technologies, protective clothing and uniforms, housekeeping contracting, and the use of signage. ECU also scheduled a meeting with the U.S. government's National Institute of Health (NIH), one of the world's foremost medical research centers. The Jordanian participants from JUST and MoH toured NIH's medical waste incinerator and discussed infection control, incinerator operations, and other more general questions associated with medical waste management with an NIH official.
- **Discussions with state regulatory officials.** Participants also had a unique opportunity to discuss issues and concerns regarding regulations with North Carolina state officials in meetings coordinated by ECU. Discussion centered on the general regulatory approach, emissions standards, public and stakeholder participation in regulatory development process, etc. The Jordanian participants were particularly interested in learning about private-sector involvement in emissions monitoring and testing, which is common in most state regulatory programs.

## Overcoming Challenges

Typical of the implementation phase of projects, activities seldom go as planned. The MWMPNJ was no different. ICMA and the partners developed solutions to overcome all of the challenges that arose during the project phases and successfully implemented the project's objectives as a result.

The major challenges that MWMPNJ faced include:

- **Travel difficulties.** The Jordanian members of the project team had trouble in obtaining required travel visas to the United States. All parties who were traveling for a given exchange applied for their visas at approximately the same time, but they did not always receive the visas accordingly. In two instances, visas were granted after the travel date; in another case, the visa was rejected altogether. As a result, the Jordanian project team members missed valuable training and practical experiences in the United States. To remedy this problem, ICMA organized a special study tour for one project team member whose visa arrived after the originally scheduled exchange dates. These obstacles to travel indicate the need to apply for travel visas at the earliest possible date, at least three months in advance.
- **Shipping delays.** ICMA was responsible for procuring and shipping 2 medical waste trucks and 20 carts. After procurement, a delay of almost two months occurred. The shipping company indicated that the ongoing conflict in Iraq had caused a shortage of American-flagged equipment needed to move the goods. Despite the delay, the waste

management system was launched as scheduled; in fact, the trucks and carts were stored for several months after arriving in Jordan until the agreement between JUST and MoH was signed.

- **Inadequate funding for needed upgrades.** David Lancaster, the ECU engineer, examined JUST's incinerators on his first trip to Jordan and concluded that JUST had underestimated the costs of upgrading its incinerators, which was part of their costshare responsibilities. While JUST financially supported other improvements, such as the incinerator facilities, it was clear that the project team would need to find another avenue for funding the needed upgrades. USAID, ICMA, JUST, and MoH worked together to identify funding opportunities, including tapping the Swiss government for upgrading the JUST incinerators.

### **Conclusion: Momentum for a Second Phase**

The success of the MWMPNJ has been a major factor in the new momentum to solve the medical waste management problem for the central and southern region of Jordan. Any comprehensive strategy aimed at solving the medical waste challenge for all of Jordan should fully incorporate the opportunities and resources that are now available in the northern region as the result of the project.

There remains to be done, however. The government of Jordan must build its capacity to more effectively regulate the medical waste sector. Additional training of ministry staff and changes in the regulatory approach are also needed. Third parties—the private sector, educational institutions, and/or nonprofit/professional organization—should be involved in emission monitoring and testing on behalf of the regulated entity. Additional onsite training of hospital personnel aimed at implementing good waste management practices will be key to expanding the efforts throughout and beyond the northern region. The healthcare system needs to have standard policies and procedures in place to ensure the proper separation of medical and other types of waste. To build on momentum and encourage action, the ministry should highlight and reward effective waste management practices and successes.

Finally, hospitals represent the most significant generator of medical waste in the northern region, however; small clinics and other medical related facilities also contribute to the risks posed by this type of waste. Any new project must address these facilities by providing them with collection and disposal services and training. ICMA stands ready to continue to provide assistance to USAID/Jordan to ensure medical waste does not adversely impact the residents of Jordan in any region.



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## Appendix A: Exchange Information

During the two-year program, five exchanges were held in Jordan and the United States. The exchanges provided the U.S. team members with an opportunity to tour facilities and speak to officials to better understand the situation in Jordan and potential solutions. Exchange provided Jordanian team members with an opportunity to tour U.S. healthcare facilities and medical waste incinerators and to discuss problems and solutions with key officials. In addition to these face-to-face exchanges, the project team kept in contact via phone and e-mail throughout the project period.

### Exchange 1

Jordan University of Science and Technology, Irbid, Jordan  
July 24–July 31, 2003

**Participants:** David George, Project Manager, ICMA; David Lancaster, P.E., Director of Engineering, ECU.

**Accomplishments:** Developed draft work plan and schedule; toured hospitals to review problem; met with Jordan Ministry of Health officials to discuss and more fully understand the problem; reviewed incinerator to understand upgrade needs and strategy.

### Exchange 2

East Carolina University, Greenville, NC  
November 29–December 9, 2003

**Participants:** Dr. Atallah Zayed Ali Rabi, Associate Professor of Public Health, JUST; Dr. Sulaiman Affash Kassab Al-Qatan, Director of Health in Irbid Governorate, MoH; Dr. Abdullah Fayez, Associate Professor of Civil Engineering, JUST; Salah Mahmoud Mousa Alyari, Assistant of Environmental Health Director, MoH; William R. Koch, M.S.E., Director of Environmental Health & Safety, ECU (Team Leader); Daniel D. Sprau, ECU; David Lancaster, Director of Engineering, ECU; and, Mike Rowe, Incinerator Operations, ECU. (Ahmad Thalji Salem AL Qatarnah, Director of Environmental Impact Assessment, MoE, was also invited but could not attend due late visa approval.)

**Accomplishments:** Completed final project work plan; toured incinerators operated by the National Institute of Health and East Carolina University; met with regulatory officials from the state of North Carolina; toured hospital and medical school and discuss policies and medical waste handling policies and procedures; developed draft workshop training agenda outlines and manuals; met with private-sector vendors involved in medical waste and hospital housekeeping.

### **Exchange 3**

JUST, Irbid, Jordan  
May 28–June 6, 2004

**Participants:** David George, ICMA; William R. Koch, MSE, Director of Environmental Health & Safety, ECU.

**Accomplishments:** Participated in two training workshops targeting administrators and medical waste generators in hospitals; led project team meetings to ensure project continuity; discussed and created outline for incinerator upgrade strategy.

### **Exchange 4**

Raleigh and Greenville, NC  
February 14–February 21, 2005

**Participants:** Dr. Abdullah Fayez, Associate Professor of Civil Engineering, JUST ; Dr. Atallah Zayed Ali Rabi', Associate Professor of Public Health, JUST; Mr. Riyad Turki Helal Alzoubi, Maintenance Department Director, JUST; Mr. Bassam Issa Alnatsheh, Environmental Health Technician, MoH; Salah Mahmoud Mousa Alyari, Assistant of Environmental Health Director, MoH. (Dr. Ali Moh'd Said As'ad, Assistant Secretary General for Primary was also invited but could not attend due late visa approval.)

**Accomplishments:** Attended Workshop on Emission Monitoring and Control (Walter Smith & Associates); worked on training workshop agenda and manual development for medical waste handlers and incinerator operations).

### **Exchange 5**

Washington, DC  
May 15–May 20, 2005

**Participants:** Dr. Hani Ahmad Mohammad Abu-Qdais, Assistant Professor of Civil Engineering JUST; David George, ICMA; Billy Paul, Division Director, Maryland Environmental Service (state regulatory agency); Terrence Carney, Chief of Operations, Georgetown University Hospital; Covanta Energy, Mark Freedman, Director; Hospitals for Healthy Environment, Cecilia DeLoach; U.S. Environmental Protection Agency.

**Accomplishments:** Toured Covanta Energy Resource Recovery Facility (Montgomery County, MD) and discussed operations and financing with officials; toured Georgetown University Hospital and discussed medical waste handling and transportation operations with officials; discussed medical waste regulatory issues with Maryland Environmental Services; discussed safer alternatives to incineration and pollution prevention opportunities with Hospitals for Healthy Environment; developed privatization strategy for medical waste sector in Jordan.









4.2.3	Develop and copy training manuals for level 2	Rabi & Hani																		
4.2.4	Conduct workshop	JUST MOH ECU																		
4.2.5	Write Report on the Workshop	Hani & Rabi																		
4.3	Provide training to level 3's (handlers, laborers, supervisors, incinerator operators)	Rabi & Hani MOH ECU																		
4.3.1	Identify trainees	JUST & MOH																		
4.3.2	Identify training needs	Rabi & Hani																		
4.3.3	Develop and copy training manuals for level 3	Rabi & Hani																		
4.3.4	Conduct workshop	JUST MOH ECU																		
4.3.5	Write Report on the Workshop	Hani & Rabi																		
4.4	Development of appropriate training and awareness materials for workshops and posting in hospitals	Rabi & Hani																		
4.4.1	Develop Website	Rabi																		
4.4.2	Single page medical waste brochure	Rabi																		





## Appendix C: Hospital Collection Routing Plan

This plan was developed to collect waste from the hospitals—an integral part of the CityLinks partnership.

Route Name	Direction		Distance(Km)	Driving Time(min)	Loading Time(min)	Rout Time(m
	From	To				
Route 1	JUST Incinerator	P.Badeeah+P.Rahma Hospital	24	28	15	123
	P. Rahmah Hospital	P. Bassma Hospital	5	13	15	
	P. Bassma Hospital	JUST Incinerator	23	37	15	
Route 2	JUST Incinerator	Mafraq Government Hospital	35	31	15	181
	Mafraq Government Hospital	Mafraq Children Hospital	5	6	15	
	Mafraq Children Hospital	Mafraq(Al-noor Hospital)	7	10	15	
	Mafraq(Al-noor Hospital)	Ramtha Government Hospital	47	45	15	
	Ramtha Government Hospital	JUST Incinerator	13	14	15	

Route 3	JUST Incinerator	Koora (P. Raya) Hospital	44	60	15	245
	Koora (P. Raya) Hospital	Ngoc (Abu Obida Hospital)	25	20	15	
	N.Ghor (Abu Obida Hospital)	N.Ghor (Mu`ad ibn jabal Hospital)	23	25	15	
	N.Ghor (Mu`ad ibn jabal Hospital)	Bani Kenanh (Yarmouk Hospital)	30	30	15	
	Bani Kenanh (Yarmouk Hospital)	JUST Incinerator	23	35	15	
Route 4	JUST Incinerator	Ajloon (Al Iman Hospital)	45	50	15	170
	Ajloon (Al Iman Hospital)	Jarash Government Hospital	25	30	15	
	Jarash Government Hospital	JUST Incinerator	30	45	15	