OFFICE OF THE SPECIAL INSPECTOR GENERAL FOR IRAQ RECONSTRUCTION

MISSAN SURGICAL HOSPITAL

UNDER THE ECONOMIC SUPPORT FUND

AL AMARAH, IRAQ

SIGIR PA-08-165
SIGIR PA-08-167

JULY 16, 2009

SIGIR

Special Inspector General for Iraq Reconstruction

July 16, 2009

Summary of Report: PA-08-165 and PA-08-167

Why SIGIR Did This Study

In December 2008, the U.S. Ambassador to Iraq became increasingly concerned with the lack of progress on this project and asked SIGIR to perform an assessment.

The objective of this project assessment was to determine if:

- project components were adequately designed
- construction complied with the design standards
- adequate quality management programs were used
- project sustainability was addressed
- project results were consistent with the original objectives

What SIGIR Recommends

SIGIR recommended that the Commanding General, Gulf Region Division (GRD) of the U.S. Army Corps of Engineers (USACE), take these actions:

1. Resolve the design deficiencies, omissions, and areas of concern with the contractor.
2. Follow up with the contractor to ensure that the complete design drawings are received.
3. Require the contractor to remove and replace all defective concrete.
4. Require the local national on-site quality assurance representatives to closely monitor and ensure that the contractor removes and replaces deficient concrete

SIGIR recommended that Iraq Transition Assistance Office (ITAO) continue to coordinate with the Missan PRT, Health Attaché, and the Government of Iraq to ensure the Missan Surgical Hospital will be fully equipped, have trained staff, and funding to maintain the operations once construction is completed.

USACE, GRD, and ITAO concurred with the recommendations and provided technical comments for clarification.

For more information, contact SIGIR Public Affairs at (703) 428-1100 or PublicAffairs@sigir.mil

Missan Surgical Hospital

What SIGIR Found

On 8 January 2009, SIGIR performed an on-site assessment of the Missan Surgical Hospital project in Al Amarah, Iraq. The objective of this $12.7 million Economic Support Fund contract was to provide a state-of-the-art surgical hospital and medical training facility. Due to security concerns, the time allotted for the site visit was approximately one hour, with no access to the security gate; therefore, a complete review was not possible.

The project was significantly behind schedule. Phase I was to be complete on 24 March 2009; Phase II, on 7 September 2009. As of January 2009, both phases were listed as 26% complete. After the review, however, SIGIR estimated that each phase was approximately 10-15% complete.

The contractor agreed to provide additional workers and resources to expedite completion and more than doubled the number of workers to 25. Nevertheless, the workforce was still not large enough to construct the project in a timely manner.

SIGIR observed construction deficiencies, such as a poorly constructed security wall, areas of reinforcing steel with a coating of cement residue, reinforcing configuration used in the construction of the reinforced concrete columns that varied from the configuration specified in the design drawings, and several examples of varying degrees of concrete honeycombing—ranging from slight to moderate to severe.

The lack of detailed design drawings for the water supply and wastewater system threatens the ability of the facility to receive water and dispose of wastewater. The contractor's slow progress and construction deficiencies further delay the opening of this hospital.

The Government of Iraq was responsible for providing all equipment and staff to operate and maintain the hospital. However, the reduction in oil prices resulted in budget shortages, which delayed the Iraqi funding commitment. Any funding for this project would now have to be provided from the 2010 budget. Until these valuable assets are in place, the hospital will serve no beneficial purpose: it will not be open to treat the sick and injured citizens of Al Amarah.

SPECIAL INSPECTOR GENERAL FOR IRAQ RECONSTRUCTION

July 16, 2009

MEMORANDUM FOR UNITED STATES AMBASSADOR TO IRAQ
COMMANDING GENERAL, MULTI-NATIONAL FORCE-IRAQ
COMMANDING GENERAL, JOINT CONTRACTING COMMAND-IRAQ/AFGHANISTAN
COMMANDING GENERAL, GULF REGION DIVISION, U.S. ARMY CORPS OF ENGINEERS
DIRECTOR, IRAQ TRANSITION ASSISTANCE OFFICE

SUBJECT: Report on the Missan Surgical Hospital, Al Amarah, Iraq
(SIGIR Project Numbers PA-08-165 and PA-08-167)

We are providing this project assessment report for your information and use. We assessed the design and construction work being performed at the Missan Surgical Hospital, Al Amarah, Iraq to determine its status and whether objectives intended will be achieved. This assessment was made to provide you and other interested parties with real-time information on a relief and reconstruction project underway and in order to enable appropriate action to be taken, if warranted.

Comments on a draft of this report from the Gulf Region Division of the U.S. Army Corps of Engineers and the Iraq Transition Assistance Office of the U.S. Embassy-Iraq addressed our recommendations and provided additional clarifying information for this final report. As a result, no additional comments are required.

We appreciate the courtesies extended to our staff by representatives of the Iraq Transition Assistance Office, the Gulf Region Division, Gulf Region District South, and the Camp Adder Area Office of the U.S. Army Corps of Engineers. If you have any questions please contact Mr. Brian Flynn at brian.flynn@sigir.mil or at 240-553-0581, extension 2485. For public queries concerning this report, please contact SIGIR Public Affairs at publicaffairs@sigir.mil or at 703-428-1100.

Stuart W. Bowen, Jr.
Inspector General

Special Inspector General for Iraq Reconstruction

SIGIR PA-08-165 **July 16, 2009**
SIGIR PA-08-167

Missan Surgical Hospital
Under the Economic Support Fund
Al Amarah, Iraq

Synopsis

Introduction. The Special Inspector General for Iraq Reconstruction (SIGIR) is assessing projects funded under the Economic Support Fund to provide real-time information on relief and reconstruction projects in the Missan province.

Project Assessment Objective. The objective of this project assessment[1] was to provide real-time information on relief and reconstruction projects to interested parties to enable appropriate action, when warranted. Specifically, SIGIR determined whether:

1. Project components were adequately designed prior to construction or installation;
2. Construction or rehabilitation is in compliance with the standards of the design;
3. Adequate quality management programs were being utilized;
4. Sustainability was addressed in the contract or task order for the project; and
5. Project results were or will be consistent with their original objectives.

SIGIR conducted this limited scope assessment in accordance with the Quality Standards for Inspections issued by the Council of the Inspectors General on Integrity and Efficiency. The assessment team comprised two engineers/inspectors and two auditors/inspectors.

Project Objective. The overall objective of the project was to provide the residents of Al Amarah with the only state-of-the-art surgical hospital in the Missan[2] province, as well as a medical training facility for medical students from Missan University Medical College. Specifically, the Missan Surgical Hospital (MSH) will be the new health care campus constructed in the town of Al Amarah to provide health care services to the people of Missan province.

Costing $12.7 million, the Missan Surgical Hospital is the largest health project funded by the U.S. government for this province. The Iraqi Minister of Health views it as the single most important development in Missan province.

Request for Additional Information. In late 2008, the U.S. Ambassador became concerned with the lack of progress in the construction of the MSH. The U.S. Ambassador's concerns focused on the original need for the project in Missan province, the decision to locate the hospital at some distance from the population with limited road access, the contractor's commitment to complete the project in a timely manner, and the

[1] The Missan Surgical Hospital consists of two separate phases, each funded with the Economic Support Fund. Since a portion of Phase II enlarged aspects of Phase I, it would be impossible to assess one phase without commenting on the other phase. Therefore, this assessment addresses both phases.

[2] There are various spellings of the province "Missan" in various documents related to this project. For consistency with this report, unless used in a verbatim quotation, SIGIR refers to it as "Missan."

ability of the Government of Iraq (GOI) to properly equip, operate, and maintain the facility after it was transferred to their control. With these concerns in mind, the U.S. Ambassador asked SIGIR to perform an assessment of the MSH project.

Answers to the U.S. Ambassador's Questions. Health facilities in Missan province are not sufficient to meet the needs of the population, and only limited outreach services are available for rural areas. Existing health care facilities in the province are generally dilapidated and have a poor standard of hygiene. In an attempt to improve the quality of health care for the province, the Missan Provincial Reconstruction Team (PRT) discussed the idea of a 100-bed hospital with the Missan Provincial Council and Ministry of Health (MOH). The original justification for this project stated that the MSH would directly benefit over 100,000 Iraqi citizens. The GOI decided to locate the hospital in the city of Al Kahla because the city had no existing hospital and only one clinic to serve its citizens. According to project file documentation, without this project, the "mortality rate in the Al-Kahla district will continue to rise and be a trouble spot for the Government."

After the U.S. government approved the funding for the MSH in Al Kahla, the Governor of Missan and the MOH changed the location of the hospital from Al Kahla to a remote area within the capital city of Al Amarah. The project file lacked a detailed explanation as to why the Missan Governor changed the site location, especially considering that the district of Al Kahla does not have a hospital; while Al Amarah has two. Possibly as a compromise for moving the hospital from Al Kahla to Al Amarah, the MOH agreed to fund the construction of a hospital in the Al Kahla district; however, the MOH gave no time frame for the construction of this second hospital. Until the MOH funds and constructs a new hospital, the citizens of Al Kahla will continue to have no access to adequate medical treatment.

According to Gulf Region South (GRS)[3] Adder Area Office (AAO), Iraq Transition Assistance Office (ITAO), and project file documentation, there were two reasons why the GOI decided to locate the hospital in a desolate area away from the city instead of in Al Amarah, which is congested with houses, apartment complexes, and multiple-story buildings. First, constructing this hospital complex in the city would require significant demolition of existing homes, apartments, and commercial buildings. This could potentially uproot and relocate Missan residents and present a monumental logistics challenge for the contractor to bring all the construction materials to the site (and through the heart of the city). Second, the cost of the project would have increased to include tearing down existing structures. In addition, an Al Amarah city development plan envisioned the hospital attracting more development to include new housing areas that could be located near the hospital.

During a visit to the project in December 2008, the U.S. Ambassador noted only 10 workers on site and questioned the contractor's commitment to completing the facility in a timely manner. The contractor agreed to provide additional workers and resources to expedite completion. SIGIR's site visit, which occurred approximately one month after the U.S. Ambassador's visit, documented roughly 25 workers on site. Even though the number of workers on site had more than doubled, the workforce was still not large enough to construct the project in a timely manner.

[3] GRS is one of three districts under the U.S. Army Corps of Engineers (USACE) Gulf Region Division (GRD). GRD and its three districts provide construction management services and assist the capacity of the GOI to maintain its own construction, operation, and maintenance program of essential services and national infrastructure.

At the time of SIGIR's site visit, the project was significantly behind schedule. According to the contract, Phase I was to be complete on 24 March 2009; Phase II, on 7 September 2009. GRS documentation indicated that as of January 2009, Phases I and II of the project were each listed as 26% complete. Based on the 8 January 2009 site visit, SIGIR concluded that neither phase of the project was close to 26% complete. SIGIR estimated that each phase of the project was approximately 10-15% complete.

The project, as agreed to by the Missan PRT and MOH, required the U.S. government to fund only the construction of the facility and ancillary structures; the GOI was responsible for providing all equipment (including furniture) and operating the hospital after accepting the project. The awarding of U.S. funding for the project was "contingent upon written approval of the Iraq Ministry of Health indicating that they will equip, accept, and operate the hospital upon completion." On 21 August 2007, the MOH provided a letter that stated the following:

> *"We would like to inform you and to confirm that our health minister office is ready to provide this hospital with professionally trained staff and all medicine, medical equipment and furniture. Also, we are ready to train service staff for maintenance, operation, and the use of medical equipment as well as provide an annual operating budget."*

The recent fluctuation in oil prices has resulted in budget uncertainty for the GOI, including the funding of projects for the MOH. This project will require a significant up-front financial investment to procure the extensive medical equipment and furniture required to open the facility to the public. It will also require a large annual investment to provide the necessary resources to operate and sustain the facility, such as:

- fuel to run the generators
- cleaning and maintenance staff
- trained doctors and nurses
- salaries for doctors, nurses, and guards
- the necessary pharmaceuticals for hospital patients

In addition, the GOI will need to construct paved roads to the hospital to allow for easier access by the citizens of Al Amarah.

In order to determine the GOI's ability to equip, operate, and maintain this facility after turnover, SIGIR contacted the U.S. government agencies that are directly involved with the construction and turnover of the facility (GRS and ITAO) and the U.S. government agencies that interface with the GOI on health and governance issues (Health Attaché and Missan Provincial Reconstruction Team). The contractor's construction quality and the ability of the GOI to equip, operate, and maintain this facility after transfer are addressed throughout the body of this report.

Conclusions. The assessment determined that:

1. The U.S. government provided the preliminary design (80% for Phase I and 15% for Phase II) to the contractor. The contract's Statement of Work required the contractor to develop the preliminary package into a complete design package. Specifically, the Statement of Work required the contractor to review the preliminary designs and "correct any conflict or deficiency, also provide any missing or required details or drawings."

SIGIR reviewed the contractor-generated drawings, which contained specific information on the site utilities, site drainage, sewage collection system, and other project features. SIGIR determined that with the exception of two project features, there was adequate information to complete the final design and construct the facility. However, SIGIR did identify several deficiencies, omissions, and areas of concern in the contractor-generated drawings. To deliver a fully functioning and sustainable hospital, the design deficiencies, omissions, and areas of concern need to either be corrected or clarified.

Currently, this project lacks complete design drawings that show how water will be provided to the hospital and how wastewater from the hospital will be disposed of. SIGIR is concerned about the lack of planning associated with these aspects of the project, especially for water supply. According to GRS, the current plan is to place the river intake near the intersection of the Tigris and Al Kahla Rivers and then run the water lines to the hospital site. However, this would require the contractor to excavate and lay two pipelines a total of 3.1 kilometers through a significant portion of the city of Al Amarah. SIGIR believes that excavating through the city will be intrusive to the city's residents and will be slow and dangerous work for the contractor. In addition, the design plan sheet for the river intake pump station lacked significant detail to ensure proper construction of the facility.

Similar to the water supply, the design for the wastewater system lacked significant details, such as the alignment and outfall of the sewage leaving the hospital site. The overall schematic drawing of the wastewater treatment plant indicates that the sewage leaving the hospital will be deposited directly into the "main city network nearest manhole" without identifying:

- the exact location and distance to the nearest manhole
- the size, elevation, and condition of the main city network sewer pipe
- whether or not an analysis has been performed to determine if the existing city network system can accommodate the significant additional flow from the hospital

To ensure that sewage does not back up into the hospital, local homes, and streets of Al Amarah, it is important that the network have capacity to handle the additional flow.

2. During the 8 January 2009 site visit, SIGIR observed that construction work, such as concrete formwork and preparation for concrete placement was ongoing. Due to security concerns, the on-site visit was only 60 minutes, and access to the security wall was restricted to 50 feet because of unexploded ordnance in the area. SIGIR observed construction deficiencies, such as a poorly constructed security wall, areas of reinforcing steel with a coating of cement residue, reinforcing configuration used in the construction of the reinforced concrete columns that varied from the configuration specified in the design drawings, and examples of concrete honeycombing—ranging from slight to severe.

   SIGIR discussed these deficiencies identified with the GRS AAO; specifically, the concrete honeycombing and the contractor's inadequate attempts to correct it. The GRS AAO took immediate action by making multiple visits to the project site to determine the extent and severity of the honeycombing. The GRS AAO Resident Engineer concluded that five columns and the wall required demolition.

However, the contractor hired the University of Technology to investigate the concrete issue. The University of Technology's report recommended the removal of defective concrete and replacement with a suitable repair material ("Portland cement mortars, proprietary cementitious materials, or polymer-grouts). SIGIR reviewed the University of Technology's findings and recommendations and concluded that the recommended strategy is typical for the repair of honeycombed concrete and should be within the capabilities of a competent contractor.

3. The contractor's quality control (QC) plan was sufficiently detailed to effectively guide the contractor's quality management program. The contractor submitted a QC plan, which was accepted by the GRS AAO as meeting the standards addressed in Engineering Regulation 1180-1-6 (*Construction Quality Management)*. The QC representatives monitored field activities and completed daily QC reports, which presented a brief background on the number of workers on site, the work activities performed on site, and major equipment on site. However, the daily QC reports did not have a section for construction deficiencies identified; consequently, the QC reports failed to document the obvious concrete honeycombing issues that SIGIR identified during the site visit. In addition, the daily QC reports did not mention safety issues at the project site, such as protruding reinforcement bars and nails from broken-down formwork boards, which SIGIR observed in numerous locations. Further, SIGIR noticed that the project site was cluttered with building materials, which posed tripping hazards to the contractor's crew and visitors to the site. The protruding reinforcement bars and nails, combined with multiple tripping hazards, increase the likelihood of injury or death. Finally, the GRS AAO questioned the accuracy of the daily QC reports. Specifically, in a letter of concern to the contractor, GRS AAO stated the following:

   > *"In the visits to the project site by US personnel we have noted that the number of Contractor personnel reported on both the Phase I and Phase II Quality Control Report to be working at the site is higher than the actual Contractor personnel observed at the site."*

   Hampered by local area security issues and the project site's remote location, the U.S. government quality assurance (QA) program has not been effective in monitoring the contractor's QC program. GRS AAO employed local Iraqi national QA representatives to monitor field activities and complete daily QA reports, which were reviewed by the GRS AAO project engineer. The daily reports documented the number of workers on site and the daily work performed. However, the daily reports did not document the obvious concrete honeycombing issues SIGIR identified during the site visit. It appeared that someone must have brought the concrete honeycombing issue to the attention of the contractor because the contractor attempted to correct the issue at least once; however, the daily QA reports are silent on this matter. In addition, in some instances, the QA representatives did not enforce proper safety procedures. SIGIR observed numerous protruding reinforcement bars and nails, which posed a significant safety hazard to the contractor's workforce and visitors to the project site.

   After SIGIR's site visit, GRS AAO representatives developed a new QA format and emphasized the importance of documenting construction deficiencies. GRS AAO provided a sample of QA reports written after the site visit, which SIGIR found to be more detailed, especially at identifying and documenting construction deficiencies.

4. Sustainability was addressed in the contract requirements. The Statement of Work included sustainability elements to assist the Iraqi ministry ultimately responsible for operating this project after turnover. The contract specifications require the contractor to provide and certify warranties in the name of the appropriate ministry for all materials and equipment. In addition, the contractor is required to perform operations and maintenance training appropriate to the facilities and equipment installed, constructed, or rehabilitated in the scope of this project, along with providing operations and maintenance manuals. Further, the contract required the contractor to provide individual price lists of spare parts and consumable items considered to be essential during the first two years of operation of the new equipment. Upon completion of each facility, the contractor must prepare and furnish as-built drawings, which will be a record of the construction as installed and completed.

   Finally, though not required by the contract, the U.S. government provided the GOI with a comprehensive list of all equipment (by department) necessary to fully furnish and operate the hospital, including the department name, room name, room number, room quantity, item quantity, description of each item, manufacturer, and specific model.

5. To date, the MSH project results are consistent with the original project objectives to construct a surgical hospital and associated ancillary facilities for the residents of Al Amarah. However, the lack of detailed design drawings for the water supply and wastewater system threaten the ability of the facility to receive water and dispose of wastewater—essential components of an operational surgical hospital.

   The original project objectives of the U.S. government were to provide the citizens of Al Amarah with a surgical hospital building and associated ancillary facilities only; the GOI is responsible for providing all the medical equipment, furniture, and personnel (i.e. doctors and nurses) necessary to open, operate, and maintain the project. As of May 2009, the GOI has yet to procure any equipment or identify the specialized doctors and nurses needed to staff the MSH. Further, the GOI pledged in August 2007 that in addition to identifying a professionally trained staff, it would "provide an annual operating budget;" however, almost two years later, the GOI has yet to allocate any funding for this project. Specifically, the local Director General (DG) for Health's 2009 budget is "thoroughly committed" with no funding for this project. Any funding for this project would have to be provided from the 2010 budget. The DG for Health requested the U.S. Embassy engage the MOH in order to better focus the MOH on the need to better plan now to meet its commitment to this project. In order to serve the people of Al Amarah, the GOI will be required to provide these valuable assets.

   Finally, the contractor's slow progress and construction deficiencies further delay the completion of this hospital.

Recommendations. SIGIR recommends that the Commanding General, Gulf Region Division of the U.S. Army Corps of Engineers, take these actions:

1. Resolve the design deficiencies, omissions, and areas of concern with the contractor to guarantee that the project is adequately designed.
2. Follow-up with the contractor to ensure that the complete design drawings include water distribution lines from the river intake to the hospital site and wastewater distribution lines from the hospital site to the appropriate sewer line connection.

3. Require the contractor to remove all defective concrete and replace it with a suitable repair material.
4. Require the local national on-site quality assurance representatives to closely monitor and ensure that the contractor removes and replaces deficient concrete.

To protect the U.S. government's investment of approximately $12.7 million, SIGIR recommends that ITAO continue its efforts to coordinate with the Missan PRT, Health Attaché, and GOI to ensure that the MSH will be fully equipped, have trained staff available, and funding to maintain the operation of the facility once construction has been completed.

Management Comments. SIGIR received comments on the draft of this report from the Gulf Region Division of the U.S. Army Corps of Engineers and the Iraq Transition Assistance Office of the U.S. Embassy-Iraq, concurring with the recommendations in the report. The U.S. Army Corps of Engineers also provided technical comments for clarification. SIGIR reviewed the comments provided by the U.S. Army Corps of Engineers and revised the final report as appropriate.

Evaluation of Management Comments. SIGIR appreciates the concurrences by the U.S. Army Corps of Engineers and U.S. Embassy-Iraq with the draft report's recommendations. Their comments addressed our recommendations and provided additional clarifying information for this final report. As a result, no additional comments are required.

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Introduction

Objective of the Project Assessment

The objective of this project assessment was to provide real-time relief and reconstruction project information to interested parties to enable appropriate action, when warranted. Specifically, the Special Inspector General for Iraq Reconstruction (SIGIR) determined whether:

1. Project components were adequately designed prior to construction or installation;
2. Construction or rehabilitation is in compliance with the standards of the design;
3. Adequate quality management programs are being utilized;
4. Sustainability is addressed in the contract or task order for the project; and
5. Project results were or will be consistent with their original objectives.

SIGIR conducted this limited scope assessment in accordance with the Quality Standards for Inspections issued by the Council of the Inspectors General on Integrity and Efficiency. The assessment team comprised two engineers/inspectors and two auditors/inspectors.

Request for Additional Information

Considering the cost and significance of the Missan[4] Surgical Hospital (MSH), in late 2008 the U.S. Ambassador became increasingly frustrated and concerned about the lack of progress. In addition, the U.S. Ambassador was concerned about the commitment of the contractor to complete the project in a timely manner and the Government of Iraq (GOI) to properly equip, operate, and maintain this facility once it is transferred to their control.

The U.S. Ambassador requested SIGIR to perform an assessment of the MSH to determine the following:

- the original need for this project
- the decision to locate this hospital in a remote area of the province with no road access
- current status of construction, including whether or not the contractor has enough workers on site to complete the project on schedule
- the capability of the GOI to accept, operate, and maintain this project

The status of construction, including quality and number of workers on site, will be discussed in the Site Assessment section of this report.

Missan Province

Missan province lies in the southeastern part of Iraq, within the Precipitation Valley (Figure 1). The total area of the province is 16,072 square kilometers (km^2), which represents approximately 4% of the total land area of Iraq. Missan is bordered from the north by the Wasit province, from the east by Iran, from the west by Dhi Qar province,

[4] There are various spellings of the province "Missan" in various documents related to this project. For consistency with this report, unless used in a verbatim quotation, SIGIR refers to it as "Missan."

and from the south by Basrah province. The geographical nature of the province is divided between land and water, where the marshlands form more than 40% of the total area extending between its southern and southeastern parts as well as the southwestern part. The Tigris River flows in the middle of the province along with numerous branches originating from the eastern side of the province. The lands of Missan are known for their high fertility and variation between clay and mixed soils that form the largest part of the land area in the province, except for some parts that are covered by sand dunes.

Figure 1. Location of Missan province within Iraq

Approximately 900,000 people reside in Missan province– 60% in urban areas, 40% in rural areas. The majority of Missan's citizens practice the Shiite branch of Islam, with a much smaller minority of Sunni citizens. The capital city of Al Amarah also has a small minority of Chaldean, Christian, and Mandaean communities. Missan has a strong tribal history and approximately two thirds of the province's populations have tribal affiliations.

Missan has experienced several waves of displacement due to the Iran-Iraq War, Saddam's brutal suppression of the Shiite uprising following the first Gulf War, as well as political and religious persecution.

The geographical landscape was once dominated by marshlands, which covered approximately two thirds of the province and supported various types of livelihoods, such as farming, fishing, hunting, reed-gathering, and the grazing of water buffalo. After Saddam's devastating drainage campaign in 1991, less than a quarter of the marshes remained. The remaining landscape is now approximately 25% arable land and more than 50% desert. In addition, Saddam's draining of the marshes in the 1990s destroyed

the livelihood of many Marsh Arabs, forcing them to leave the area for neighboring countries.

Need for Healthcare in Missan Province

Missan province has some of the most concerning health indicators in Iraq. Health facilities in the province do not meet the needs of the population, and only limited outreach services are available in rural areas. The population has a high level of illiteracy and little awareness of basic health care principles. A significant health concern is water contamination. Specifically, the available water supply provides for approximately 60% of the province's needs. The rural areas rely on the marshes for their drinking water—water that is highly saline, untreated, and often contaminated because of the lack of sanitation systems. Water contamination has resulted in outbreak of dysentery throughout the province, and communicable diseases are also prevalent. The apparent causes include widespread poverty, large amounts of dust in the air, and a lack of medicine and health awareness programs.[5]

Existing health care facilities within the province are generally dilapidated and have a poor standard of hygiene. There are maternity and child-care services in district towns, but not in the rural areas. Accessibility to drugs and pharmacies varies and hospital inventories sometimes run low of critical drugs. Drugs are available at considerably higher prices at private pharmacies and are often sold without prescriptions on the black market past their expiration dates or for purposes other than their intended use. [6]

At the request of the GOI, the U.S. Army Corps of Engineers (USACE), Gulf Region South (GRS)[7] and the local Missan Provincial Reconstruction Team (PRT) discussed the idea of construction of a 100-bed hospital with the Missan Provincial Council and Ministry of Health (MOH). According to GRS documentation, the construction of this hospital presented the "opportunity to directly impact the lives of Maysanis and the quality of healthcare they receive; the continuance of the current situation contributes to the low-level of health in Maysan." Specifically, the construction of a surgical hospital would directly benefit more than 100,000 Iraqi citizens. In addition, this project presented an "opportunity for the USG [U.S. government] to cooperate with the Maysanis and solidify a relationship."

The GOI decided to locate the surgical hospital in the city of Al Kahla based on the fact that the city had no existing hospital and only one clinic to serve its citizens. In addition, the citizens of Al Kahla currently have to travel approximately 20 km from their area to the nearest hospital. According to project file documentation, "many in the area die because of overcrowding [sic] of hospital." Without this project, the "mortality rate in the Al-Kahla district will continue to rise and be a trouble spot for the Government."

Decision to Re-locate the Hospital

The Missan PRT worked with the Missan Provincial Council to identify urgent humanitarian projects to be funded through the Economic Support Fund (ESF). On 10 March 2006, the Provincial Reconstruction and Development Committee (PRDC)

[5] United Nations High Commissioner for Refugees report, "Missan Governorate Assessment Report," November 2006.
[6] United Nations High Commissioner for Refugees report, "Missan Governorate Assessment Report," November 2006.
[7] GRS is one of three districts under the USACE Gulf Region Division (GRD). GRD and its three districts provide construction management services and assist the capacity of the GOI to maintain its own construction, operation, and maintenance program of essential services and national infrastructure.

nominated the MSH project for the district of Al Kahla because of the absence of a hospital within 20 km.

According to project file documentation, the National Embassy Team (NET) convened on 16 May 2007 and 28 June 2007 to consider funding this project. The NET approved the funding for the hospital. However, subsequent to the NET's approval, the Governor of Missan and the MOH changed the location of the hospital from Al Kahla to the capital city of Al Amarah (Figure 2). The justification for the change of location was the following:

> *"For a province of 800,000 people there are currently 2 hospitals in Maysan province (az-Zahrawi which specializes in surgical procedures and as-Saddir which handles all general cases). The addition of the a [sic] new 100-bed facility in the middle of the provincial capitol [sic] will greatly benefit the people of Maysan."*

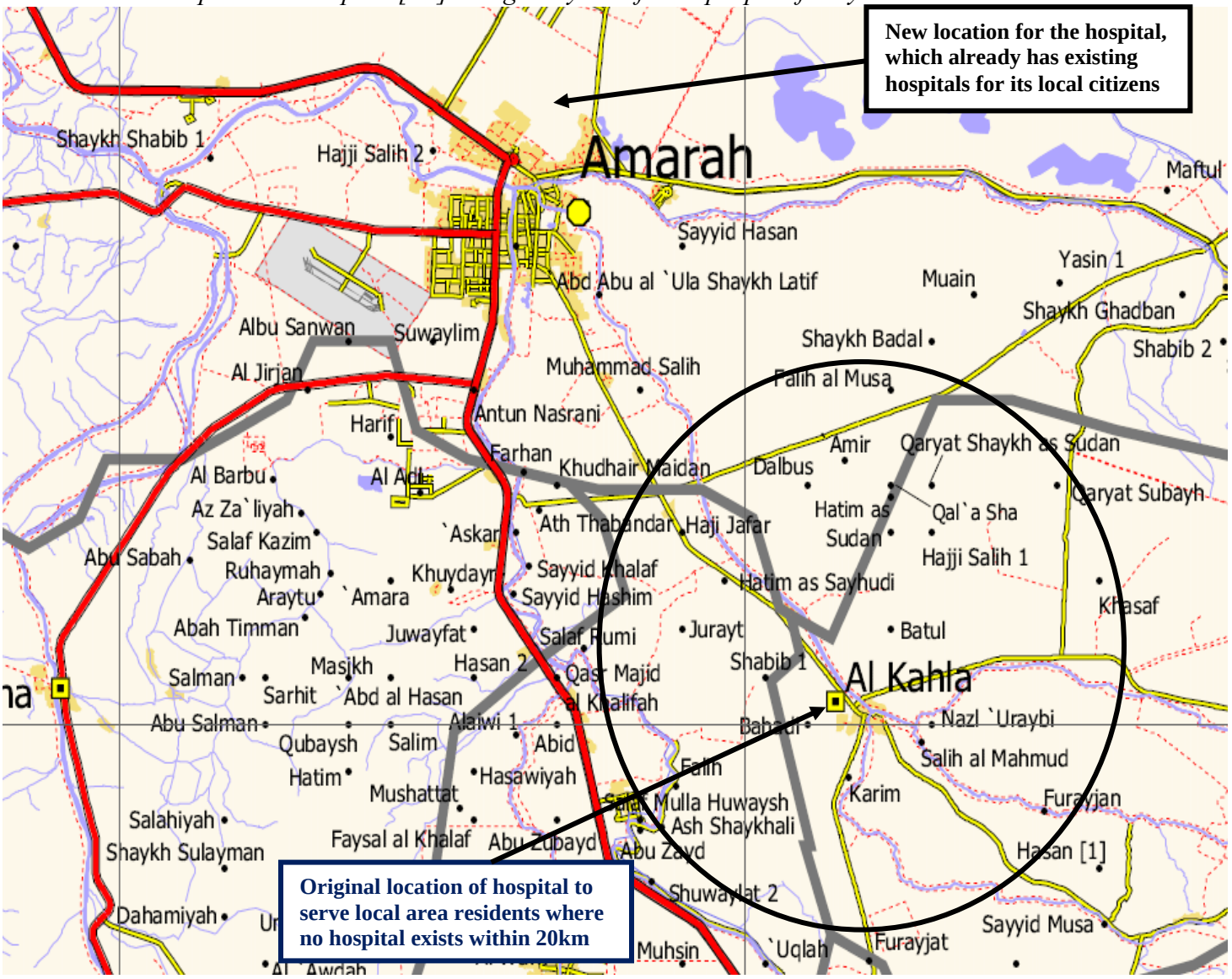


Figure 2. Original location of the surgical hospital versus the new location (Courtesy of GRS)

The project file documentation lacked a detailed explanation as to why the Missan Governor changed the site location from Al Kahla to Al Amarah, especially considering

that the district of Al Kahla does not have any existing hospital while Al Amarah has two hospitals. Possibly as a compromise for moving the hospital from Al Kahla to Al Amarah, the MOH agreed to fund the construction of a hospital in the Al Kahla district; however, no time frame for the construction of this hospital was given, and the citizens of Al Kahla will continue to have no access to a hospital. According to U.S. government representatives, as of April 2009, almost two years after the change of hospital site locations, the GOI has not funded a hospital project for the Al Kahla area.

Since the Missan governor and MOH stated that this hospital would be most beneficial in Al Amarah instead of Al Kahla, the U.S. government agreed to the location change and continued to fund both phases of this project.

Positioning the Hospital in a Remote Area With No Existing Road Access

After visiting the project site in December 2008, the U.S. Ambassador was concerned that the hospital was in a remote area of the province with no road access or bus service for citizens from the city to the hospital. The U.S. Ambassador was apprehensive that this hospital will be built in an area that cannot be easily accessed by the local citizens, which would negate any benefits for the province's citizens. The U.S. Ambassador requested that SIGIR determine the feasibility of locating the MSH in this area.

According to project file documentation, prior to construction, the project site was a barren field. An existing power line runs parallel to the project site; however, it was unknown whether the power line is operational.

In order to visit the project site, the U.S. Army drove SIGIR inspectors through Al Amarah to the northern outskirts of the city. SIGIR confirmed that there is no existing paved road connecting the city to the hospital; SIGIR traveled 1.5 miles outside the city limits on an uneven dirt road to the hospital location (Site Photos 1 and 2 and Figure 3). According to GRS and ITAO representatives and project file documentation, there were two reasons why the GOI decided to locate the hospital in a desolate area away from the city instead of the city of Al Amarah, which is congested with houses, apartment complexes, and multiple story commercial buildings. First, constructing a new hospital complex in the city would require significant demolition of existing homes, apartments, and commercial buildings, potentially uprooting and relocating Missan residents and presenting a logistics challenge for the contractor to bring all the construction materials to the site through the heart of the city. Second, the cost of the project would have increased to include tearing down the existing structures.

In addition, an Al Amarah city development plan envisions the city expanding into this area potentially attracting a new housing community around the hospital. Lessons learned from elsewhere in Iraq lend support to this assumption. For example, in a previous SIGIR Inspections report of the Basrah Courthouse and Witness Protection Facility, GRS and courthouse representatives stated that prior to construction of the new courthouse facility the surrounding area was undeveloped and inhabited primarily by squatters. After the construction of the courthouse facility, the value of the undeveloped land has more than tripled as developers are building a housing market around the courthouse.

Site Photos 1 and 2. Uneven, dirt road leading from the northern part of Al Amarah to the MSH

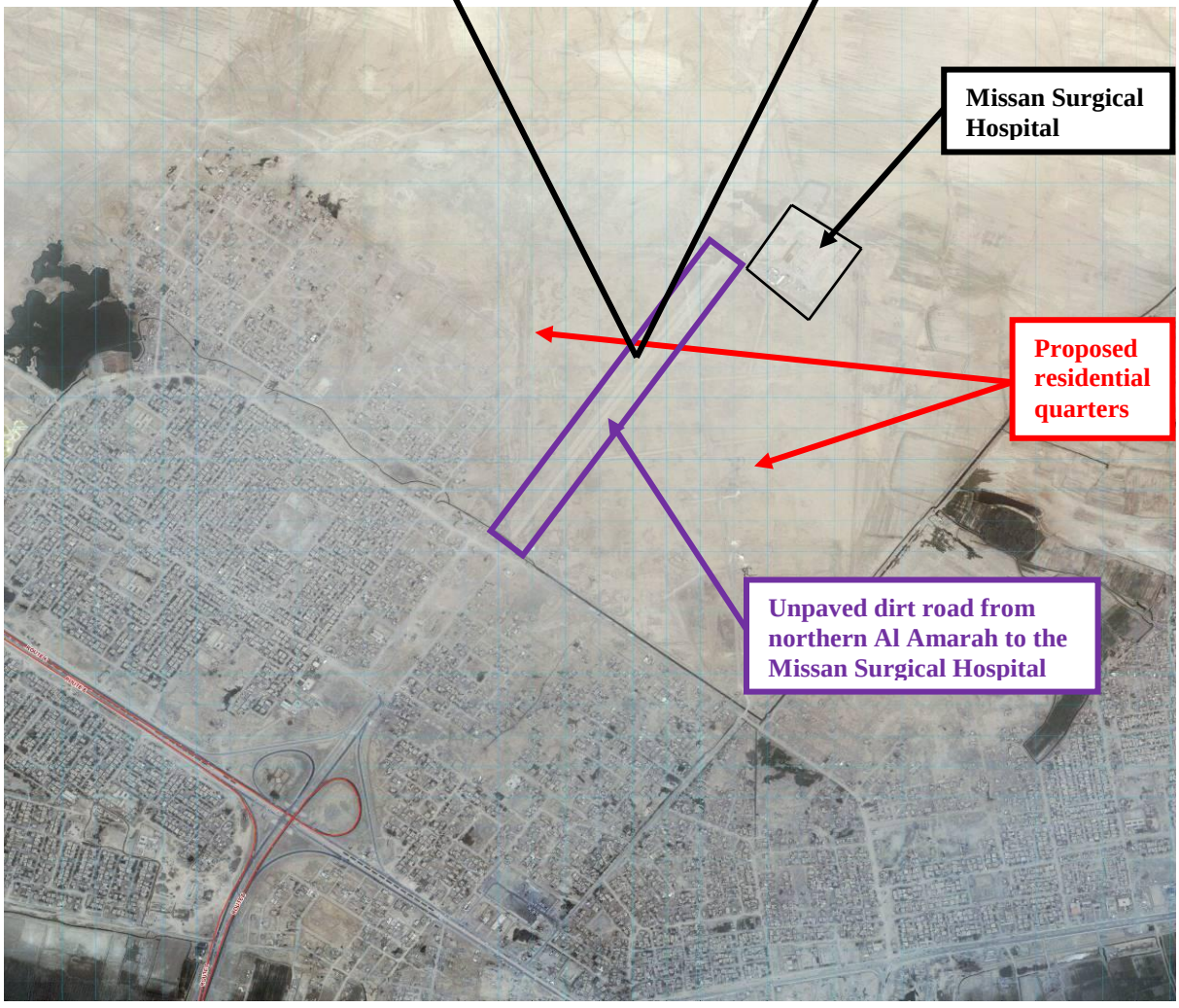


Figure 3. Aerial view of the Al Amarah city, including the MSH
(Courtesy of National Geospatial-Intelligence Agency)

GOI Accepting Responsibility to Maintain the Hospital

This project, as agreed on by the Missan PRT and MOH, required the U.S. government to fund only the construction of the facility and ancillary structures; the GOI would be responsible for providing all equipment (including furniture) and operating the hospital after accepting the project.

The U.S. Ambassador was concerned about the ability and willingness of the GOI to accept, operate, and maintain this facility after turnover. Specifically, the U.S. Ambassador expressed concerns that the GOI would be able to provide 200 medical staff. The U.S. Ambassador stated that with so few medical professionals in Iraq, it constituted a "zero-sum game" – in order to support this hospital, doctors and nurses would have to be transferred from existing hospitals.

In addition, during internal meetings, the U.S. Ambassador urged his staff to "not look at a project from only a construction point of view;" instead, determine if the GOI was "capable and had the ability to accept and maintain projects."

On 16 May 2007, the NET convened to consider funding the MSH Phase I project. Approval of the project was granted "contingent upon written approval of the Iraq Ministry of Health indicating that they will equip, accept, and operate the hospital upon completion. No contract for this project may be awarded until that written concurrence is on file at ITAO."

On 21 August 2007, the Iraqi MOH provided a letter stating the following:

> *"We would like to inform you and to confirm that our health minister office is ready to provide this hospital with professionally trained staff and all medicine, medical equipment and furniture. Also, we are ready to train service staff for maintenance, operation, and the use of medical equipment as well as provide an annual operating budget."*

With this commitment, the U.S. government proceeded with the bidding and awarding of the contract to construct the MSH.

Pre-Site Assessment Background

Contract, Costs and Payments

On 20 September 2007, USACE GRS awarded Contract W917BK-07-C-0093, a firm-fixed-price contract in the amount of $5,900,000, to a local contractor. The contract included in the original solicitation Phase I Options and Phase II, subject to the availability of funding. The U.S. government reserved the right to unilaterally exercise the option any time during the life of the contract at the negotiated fixed-price rate of $6,800,000 (Phase II).

Contract modification P00001, dated 22 January 2008, exercised Option Phase II for this project and increased the project cost from $5,900,000, to $12,700,000.

The period of performance for this project, including Phases I and II, was 550 days from the Notice to Proceed (NTP). The GRS AAO issued the construction NTPs for Phases I and II on 21 September 2007 and 6 March 2008, respectively.

Consequently, Phases I and II were to be completed by 24 March 2009 and 7 September 2009, respectively.

Project Objective

The overall objective of the project was to provide the residents of Al Amarah with the only state-of-the-art surgical hospital in the Missan province as well as a medical training facility for medical students from Missan University Medical College (Figure 4). Specifically, the MSH will be the new healthcare campus constructed in the town of Al Amarah to provide health care services to the people of Missan province. This hospital will contain a surgery department, OB/GYN department, clinic and x-ray department, and ancillary support services). The overall size of the site is approximately 62,500 square meters (m^2) (250 m x 250 m).

Figure 4. Contractor's rendering of the fully constructed MSH (Courtesy of GRS)

Health Attaché representatives stated that all existing Iraqi hospitals are old and out of date, with no new hospitals built in the past 30 years. According to project file documentation, the Iraqi Minister of Health viewed this project as the single most important development within the Missan province.

Statement of Work

The Statement of Work (SOW) required the contractor to design and construct a new healthcare campus for the Missan province in the town of Al Amarah. The SOW required the contractor to conduct a complete site investigation, including a geotechnical report with seismic analysis, and develop implementation work plans, comprehensive drawings, and descriptions of the existing site utilities and conditions.

For funding purposes, this project was broken out into two distinct phases. Phase I provides the following elements (Figure 5):

- main hospital building (38-bed facility)

- support building
- physician residence building
- sewage treatment plant
- guard house

Phase II provides the following elements:

- emergency department
- 50 additional medical patient beds
- support services
- an additional 8-bed physician residence

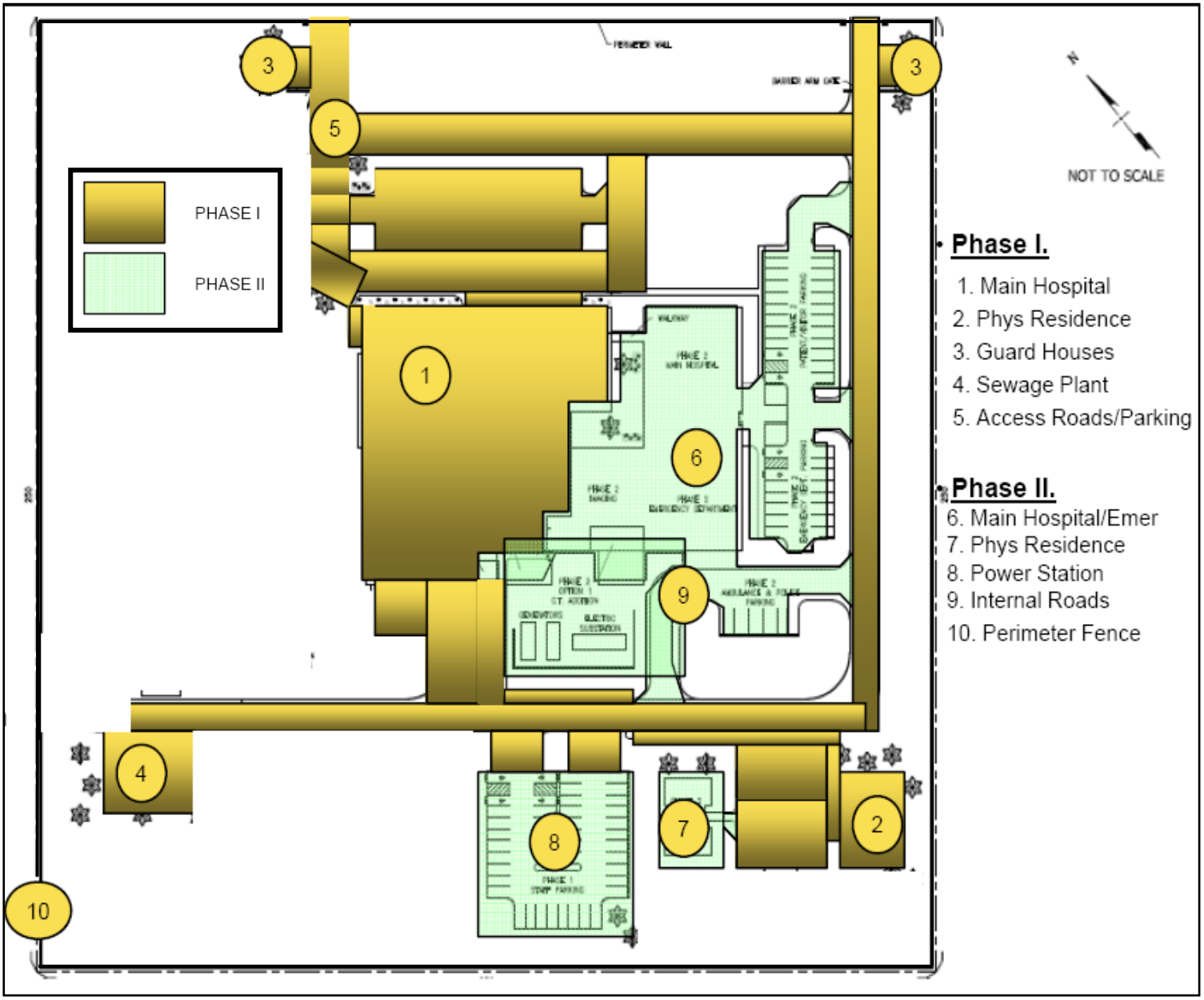


Figure 5. Master plan for Phases I and II of the MSH (Courtesy of GRS)

Project Design and Specifications

The U.S. government provided the preliminary design (80% for Phase I and 15% for Phase II), prepared by URS Corporation, to the contractor. The SOW required the contractor to develop the preliminary design package into a complete design package. Specifically, the SOW required the contractor to perform a complete site investigation, including all areas between the site and the river and between the existing road network and site (vehicular access to site). After concluding the site investigation, the contract required the following:

> "*review the 80 & 15% [preliminary design drawings] and correct any conflict or deficiency, also provide any missing or required details or drawings. Then contactor shall complete the 100% design and review the whole design to make sure the final design will work as one unit. Design shall cover all systems in the hospital."*

This information will be used to provide a complete work plan documenting the contractor's process to construct a new healthcare campus, for approval by GRS, which meets the needs of the MOH.

SIGIR reviewed the contractor generated drawings, which contained specific information regarding the site utilities, site drainage, sewage collection system, and other project features. SIGIR found limited plans regarding structural information.

After reviewing the U.S. government-provided 80% and 15% design drawings, the contractor generated drawings, and the contract's technical specifications (and the inclusion by reference of other applicable codes and standards), SIGIR determined that there was adequate information to complete the final design and construct the facility. However, SIGIR did identify several deficiencies, omissions, and areas of concern within the contractor generated drawings which need to be either corrected or clarified in order to deliver a fully functioning and sustainable hospital. The design deficiencies, omissions, and areas of concern are the following:

Storm water collection and conveyance

The storm water collection and conveyance system appeared to provide positive drainage for the project site. The drainage system relies on a storm water pump station at the low end of the system to convey water from the project site to the municipal system (Figures 6 and 7). The plans specify the pump station with two-2000 liters per minute shaft driven pumps placed in a 2 meter (m) diameter reinforced concrete structure.

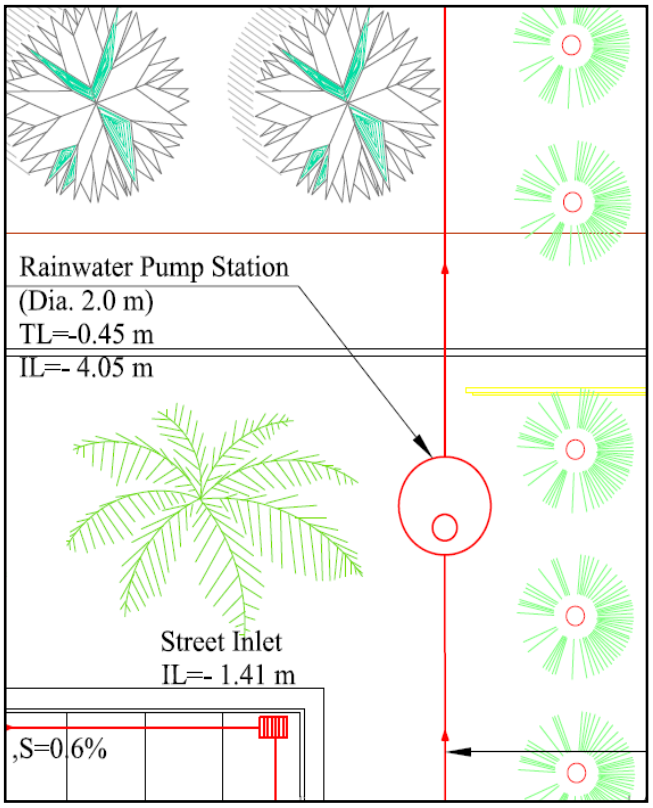


Figure 6. Storm water pump station plan

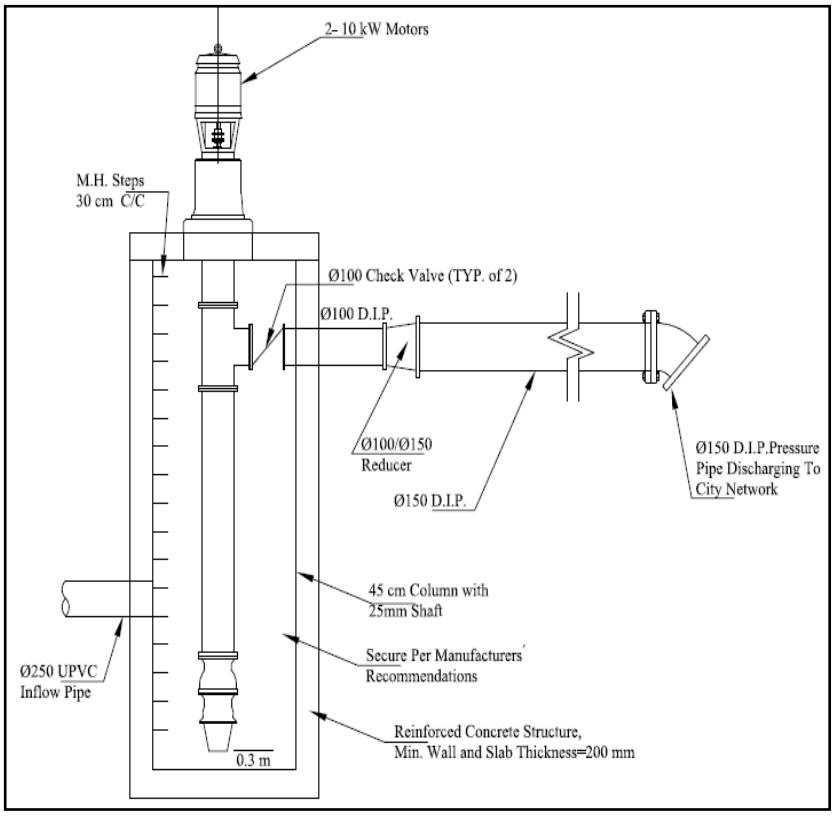


Figure 7. Storm water pump station section

The contractor's plans lacked adequate information for SIGIR to determine how the pumps are controlled or how they will address low-flow conditions. SIGIR is concerned that the high capacity of the pumps combined with the small size of the wet well may result in a rapid cycling of the pumps leading to overheating and premature pump failure.

Site utilities

Site utilities appeared to be well planned and designed to accommodate site conditions. In addition, the sanitary sewer laterals and water supply lines are located to accommodate future phases of construction. However, SIGIR's review noticed the significant use of underground fiber optic communications cables for this project, which may present future maintenance issues if the cables break or become damaged. The splicing of fiber optic cables requires specialized equipment to cleave and align the fibers and mechanically or materially fuse them together. SIGIR is concerned about the availability of specialized equipment and/or personnel properly trained in the splicing of fiber optic cables in the area.

Front external fence

The contractor's design plan detailed the perimeter fence along the north edge of the project site. The plan indicated the application of waterproofing to the portion of the wall below grade (Figure 8). However, the application of waterproofing without the integration of subsurface drainage behind the wall may allow for the buildup of hydrostatic pressure against the wall and possible localized failure of the brick infill.

In addition, the external security fence design did not include any concertina or barbed wire at the top. With only two guard houses (one at each opening to the hospital) and a wall that is only 2m high, concertina wire maybe needed to better secure the facility.

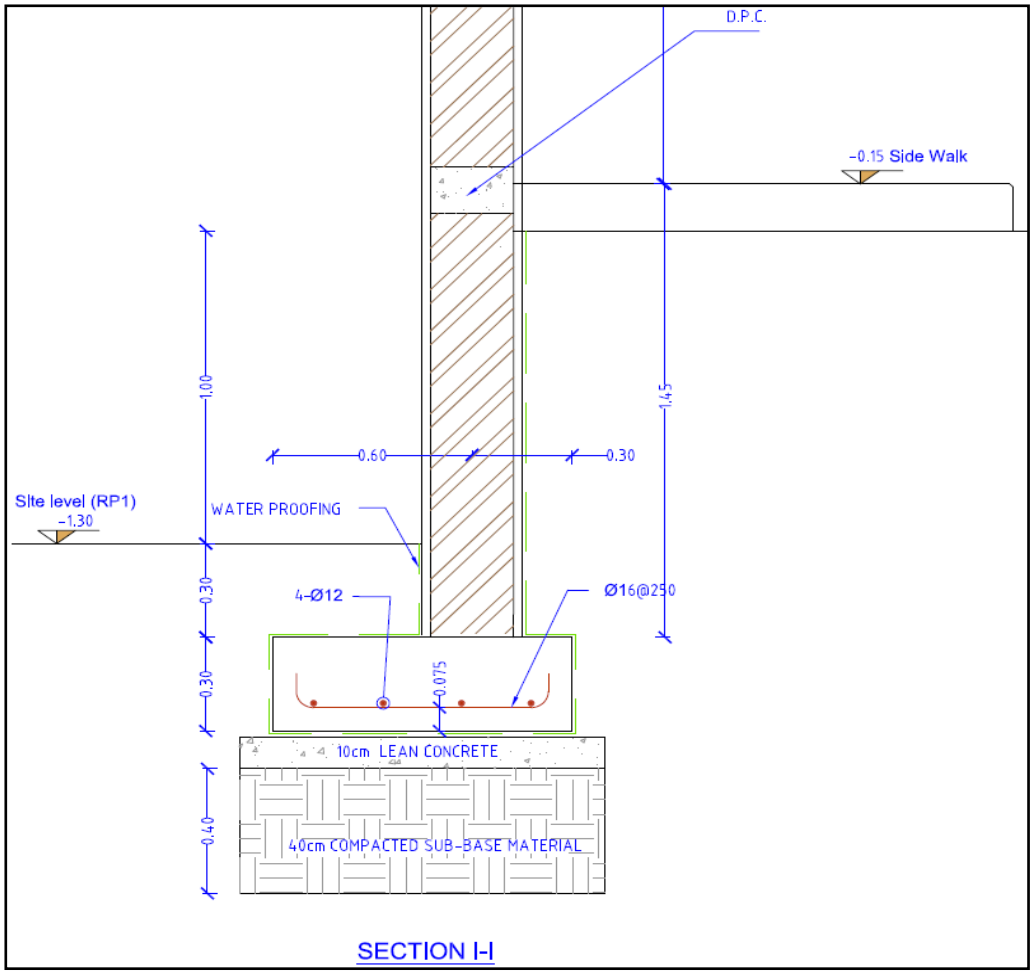


Figure 8. Perimeter retaining wall section

Guard house

The U.S. government-provided 80% design plans required that all doors and windows for the Guard House be Level 5 Ballistic. The contractor's design plan did not indicate the use of ballistic material for the doors and windows. Ballistic material is appropriate for this application (protecting the guards from possible gunfire or mortars), and it must be clarified with the contractor that ballistic material is required prior to the installation of all exterior doors and windows.

In addition, both the U.S. government and contractor's designs called for only two guard houses (one at each entrance/exit to the hospital – Figure 9). The single-story guard houses provide hospital security by checking people and vehicles as they enter the facility. However, since the guard towers are not elevated and the perimeter security wall is 2m high, the guards will have no ability to monitor any area of the facility outside of the entrances/exits. Consequently, this leaves the perimeter of the hospital site vulnerable to attack. Considering the overall size of the project site is 62,500 m^2 and the main hospital buildings obstruct a significant portion of the view

from the guard house, additional guard houses and elevated guard towers are necessary to provide adequate security.

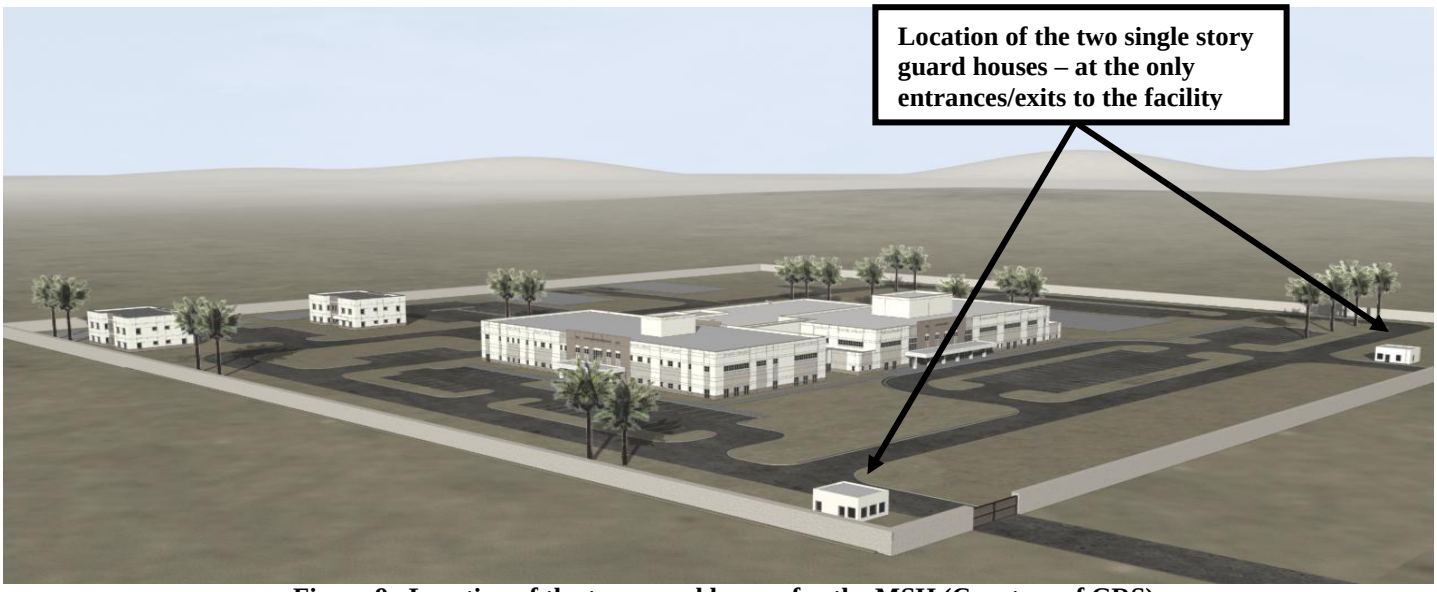


Figure 9. Location of the two guard houses for the MSH (Courtesy of GRS)

Water supply and treatment

The design of the water supply and treatment layout has changed significantly throughout the course of this project. Originally, the U.S. government provided 80% design plans requiring the following water system layout:

- raw water intake from the Al Kahla River
- duplex electric vertical turbine well pumps to supply potable water
- simplex diesel vertical turbine well pump to supply fire suppression system
- microfiltration pre-treatment for potable water
- reverse osmosis treatment for sterile water

However, when the project site was changed from Al Kahla to Al Amarah, the contractor altered the water supply and treatment design from a raw water (river) intake to a direct connection to an existing municipal (city) water line. Existing project file documentation did not identify the reason for this modification; however, the most likely reason appeared to be the change in location of the project site. Originally, the project site location was to be near the Al Kahla River, so the decision to relocate the facility to Al Amarah resulted in the necessity to find another source of raw water.

After reviewing both designs, SIGIR determined that the contractor bid for and was paid to construct a raw water intake facility. The contractor's subsequent change in design should significantly reduce the cost of the entire water supply and treatment system. Consequently, the U.S. government should seek a cost adjustment from the contractor over the modified design. On 5 April 2009, SIGIR emailed the GRS AAO representative regarding our determination that the U.S. government should seek a cost adjustment from the contractor. The GRS AAO representative responded by stating the following:

"We would agree that the contractor should provide a cost adjustment to the U.S. government for a modified water supply design if his original bid is based on the raw intake design. We will have to further investigate this particular issue."

On 23 April 2009, SIGIR gave an exit briefing of findings, conclusions, and recommendations with regard to the MSH project. During this briefing, SIGIR provided a brief history of the water supply and treatment system (i.e. the change in designs) and recommended that the U.S. government seek a cost adjustment from the contractor. All participants at the meeting agreed with the recommended course of action.

Subsequent to the exit briefing, GRS AAO representatives stated the following:

"The design drawings continue showing raw intake. The SOV from the KTR also indicates he plans on installing this system. We are not currently pursuing a municipal water line connection."

In addition, GRS provided two designs drawings for the raw water intake; both designs dated 30 April 2008. These designs, dated 8 months prior to SIGIR's site visit, were not part of the original project file documentation provided to SIGIR; instead GRS provided these drawings after the exit conference. After reviewing both designs, SIGIR determined them to be, at best, conceptual designs because they lacked specific details on piping elevations and lengths, electrical systems designs, access roads, flooding levels, and grading requirements.

Further, when placed together, the two designs clearly show a lack of detail and cohesion. For example, the SOW required two water lines – one for water processing and one for fire suppression. The "River Intake 6-5 River Intake (1)" design identified only the 150 mm water line; while the "site-maissan Water(27) WATER FIRE(27)(1)" design only identified the 75 mm water line (Figures 10-12). Also, since the security wall has already been constructed, the contractor will now have to excavate under it in order to route the water lines under the wall. In addition, the exact location of the river intake has yet to be determined; instead GRS AAO stated it will be "located approximately where the Tigris [River] and Al Kahla [River] intersect."

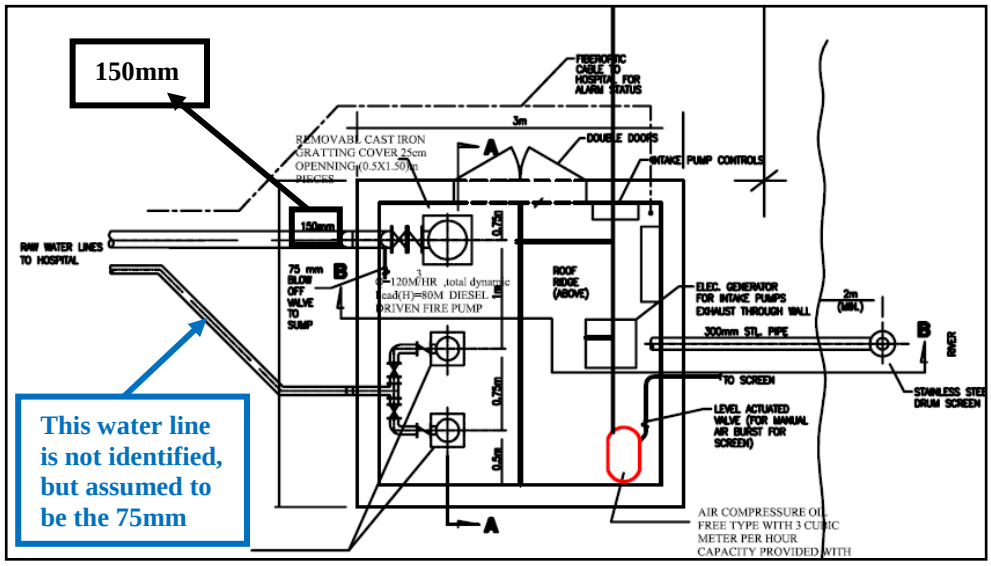


Figure 10. Contractor's river intake detail design (Courtesy of GRS)

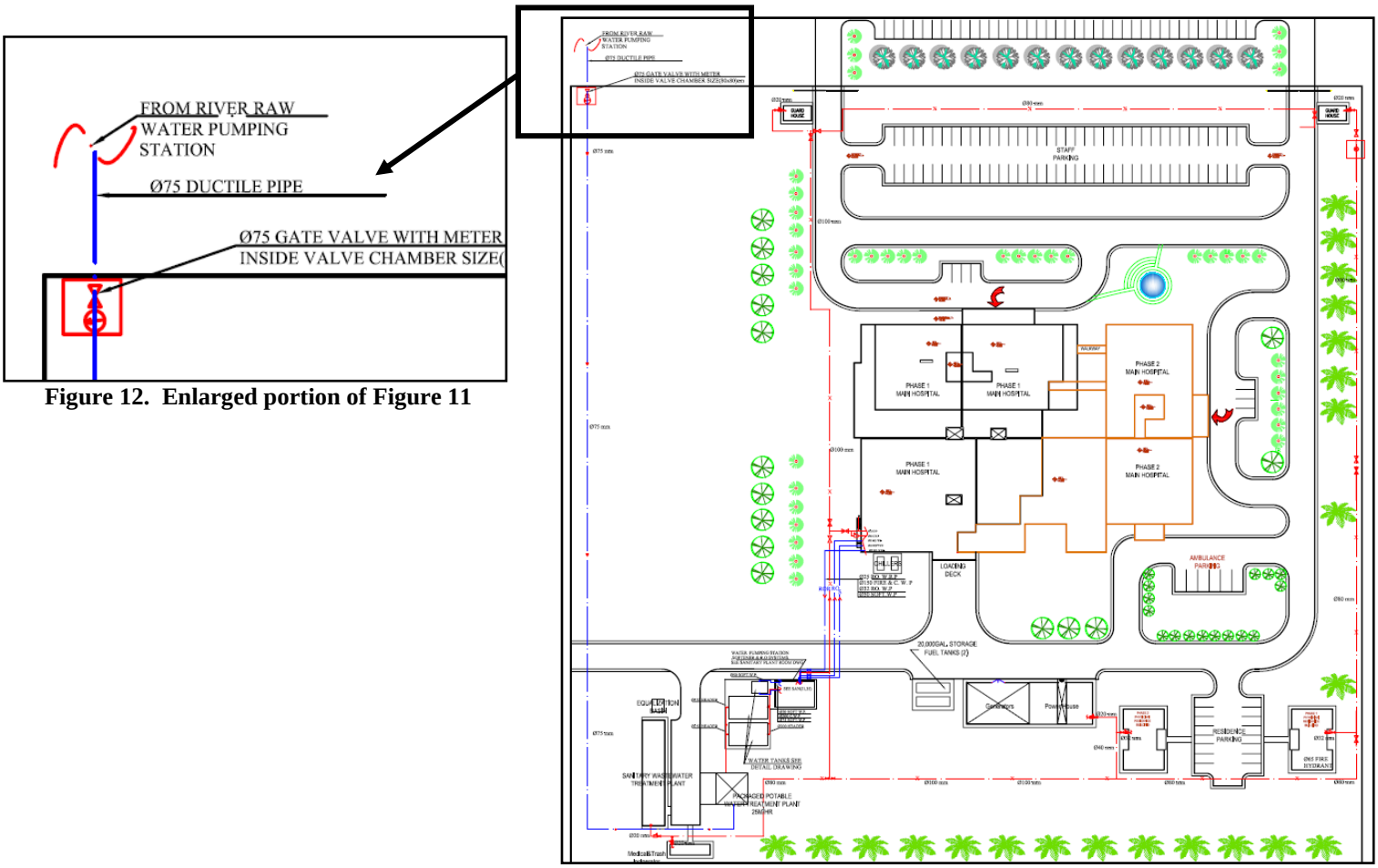


Figure 12. Enlarged portion of Figure 11

Figure 11. Contractor's water site plan (Courtesy of GRS)

More importantly, there were no design drawings for the transmission water lines from the river intake to the hospital site connection. Specifically, the size of the water line pipes, calculations performed to identify potential loss from friction, and the exact route from the project site to the river intake were not included in the design drawings. SIGIR raised these issues with the GRS AAO representatives, who stated that:

> *"the route for the water lines have not yet been finalized. The project has not reached this stage of construction and the contractor is coordinating with the municipality...we [will] acquire piping calculations once the route is finalized."*

In addition, according to GRS AAO, no assessment has been performed of the water source to determine the annual and monthly breakdown of water depth and water quality analysis. For a hospital of this size, which will require a considerable amount of water on a daily basis, a detailed assessment of the water source needed to be performed to determine if it will provide an adequate quantity and quality of water.

SIGIR is extremely concerned about the lack of planning associated with this project, specifically for the water supply and treatment. The contract requires that this project be completed by September 2009; yet as of June 2009, the exact location of the river intake, the depth and quality of the water source, and the route from the river intake to the hospital has not been determined.

Of particular concern to SIGIR is the lack of the defined route from the river intake to the hospital. According to GRS, the current plan is to place the river intake near the intersection of the Tigris and Al Kahla Rivers and then run the water lines to the hospital site. However, this would require the contractor to excavate and lay two pipe lines a total of 3.1 km through a significant portion of the city of Al Amarah (Figure 13). In a previous SIGIR Inspections report of the Falluja Wastewater Treatment Plant, SIGIR documented significant delays and serious security issues due to the fact the contractor had to excavate and lay pipe through the city.

According to GRS AAO representatives, the contractor is currently "working with the municipality for routing the water lines." However, SIGIR believes that the planning for the identification of the water source, location of the river intake, and routing of the water pipe lines to the project site needed to be done at the onset of the project, not 20 months after the NTP was issued. GRS, the contractor, and the municipality should have discussed the various options for the water supply at the beginning of the project. The delay in addressing this issue has resulted in the contractor and municipality having to determine the least intrusive method to install below ground water lines. As was learned from the Falluja Wastewater Treatment Plant inspection, excavating through a city is challenging and could be slow and dangerous work for the contractor.

In April 2009, SIGIR brought these deficiencies to GRS AAO's attention. Specifically, the latest version of design drawings GRS provided SIGIR were not detailed, omitted significant information, and were not complete.

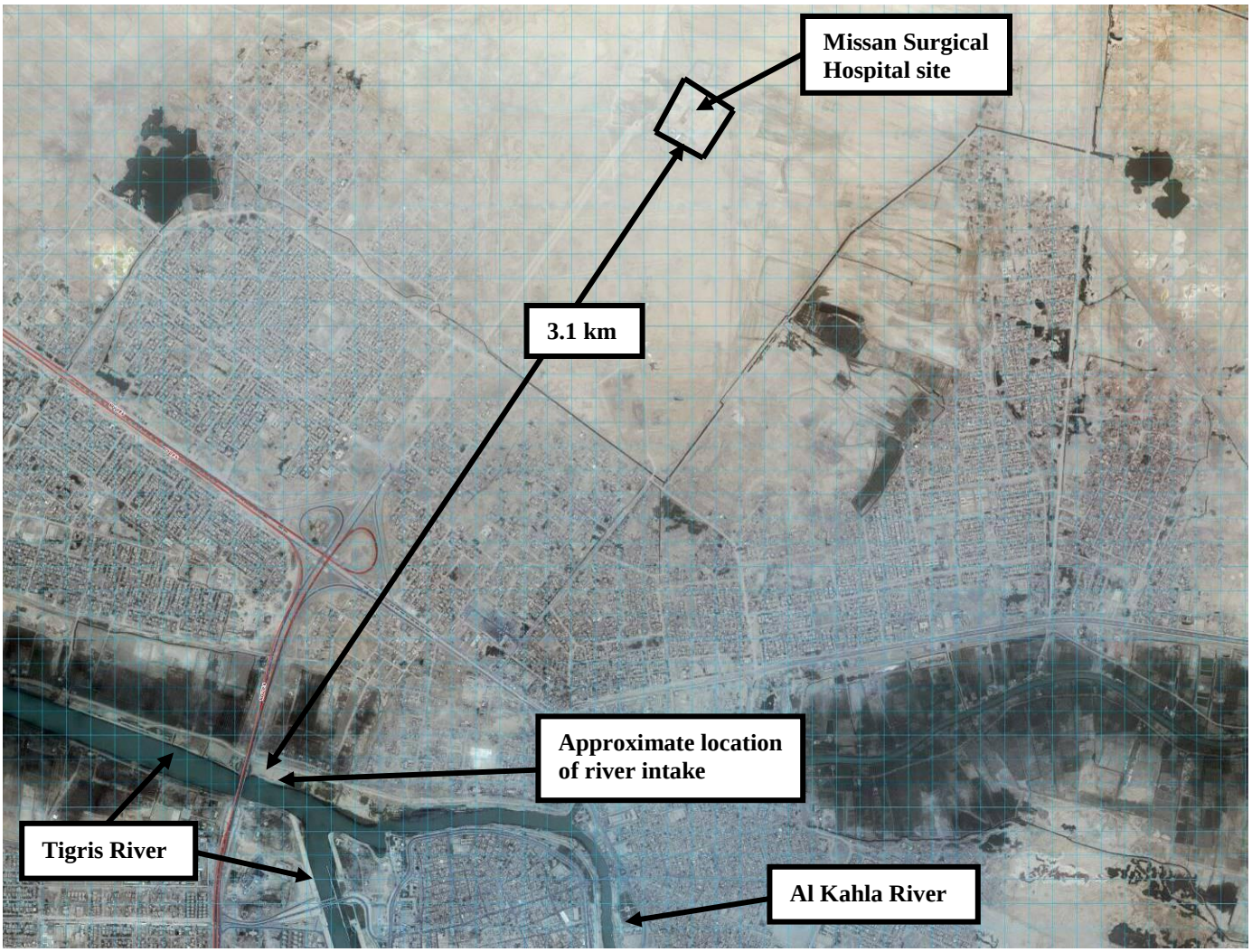


Figure 13. Aerial view of the water lines to be run from the river intake to the hospital site (Courtesy of the National Geospatial-Intelligence Agency)

Sewage treatment plant

The contractor's design for the sewage treatment plant is based on the 80% design plans with several additions. The contractor's design proposed an extended aeration package (sewage) treatment plant capable of processing 33,000 gallons per day. The design specified standard metal tanks with a poured-in-place reinforced concrete foundation mat and a treatment process, which included the following:

- flow equalization basin
- inlet bar screen
- six aeration tanks with stainless steel diffusers
- two clarifier tanks with outlet Weir
- tablet chlorinator
- outlet flow meter

Standard package aeration treatment plants typically provide adequate treatment of small design flows. High concentrations of chemical wastes from laboratories have a negative effect on the treatment process and should be avoided. Although the

discharge location was not specified in the design plans, concentrated backwash from the reverse osmosis water treatment system could also pose a problem.

After thoroughly reviewing the sewage treatment plant designs, SIGIR noticed a lack of specific details in certain areas that may be problematic during construction and/or cause issues with long-term operations and maintenance (sustainment). Specifically, the following areas lacked specific design details that may negatively affect the performance of the facility:

- The press filter room is not detailed on the plans and the type and size of filter press equipment is not indicated. The press filter room is indicated on the architectural plans with an entry of 0.45 m (18 inches) above grade. It is unclear how the sludge cake will be removed from the filter press room or how large equipment maintenance will be performed.
- The valve chamber and bypass piping for the sewage treatment plant is not detailed. Proper planning of the valve chamber and piping is essential to preclude piping conflicts and field modifications during construction.
- Float levels or alternate controls for submersible pumps are not shown. These levels should be calculated in conjunction with wet-well sizing calculations. Improperly sized wet-wells and/or improperly set pump controls may result in rapid cycling of the pumps leading to overheating and premature pump failure. Conversely, extended storage times may create septic conditions resulting in offensive odor and difficulty in treatment.

Similar to the water supply system, the wastewater system design lacked significant details, such as the alignment and outfall of the sewage leaving the hospital site. Figure 14 shows the overall wastewater treatment plant schematic drawing, which indicates that the sewage leaving the hospital will be deposited directly into the "main city network nearest manhole" without identifying the exact location and distance to the nearest manhole, the size, elevation, and condition of the main city network sewer pipe, and whether or not an analysis has been performed to determine if the existing city network system can accommodate the significant additional flow the hospital will provide. To ensure that sewage does not back up into the hospital or in nearby neighborhoods, it is important that the network have the capacity to handle the additional flow.

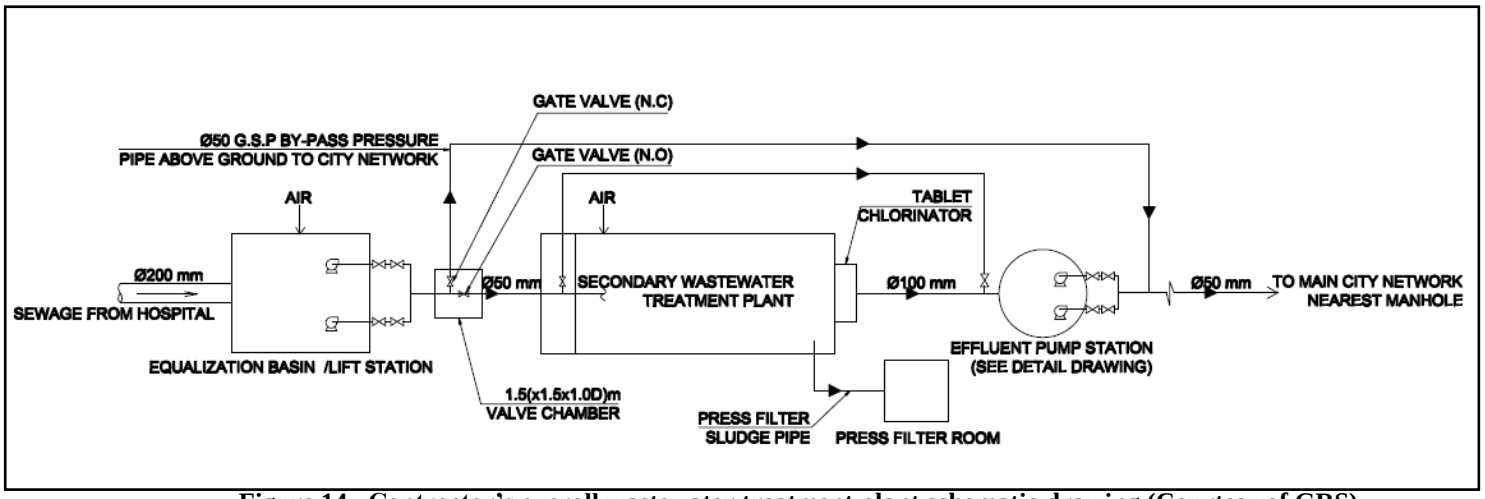
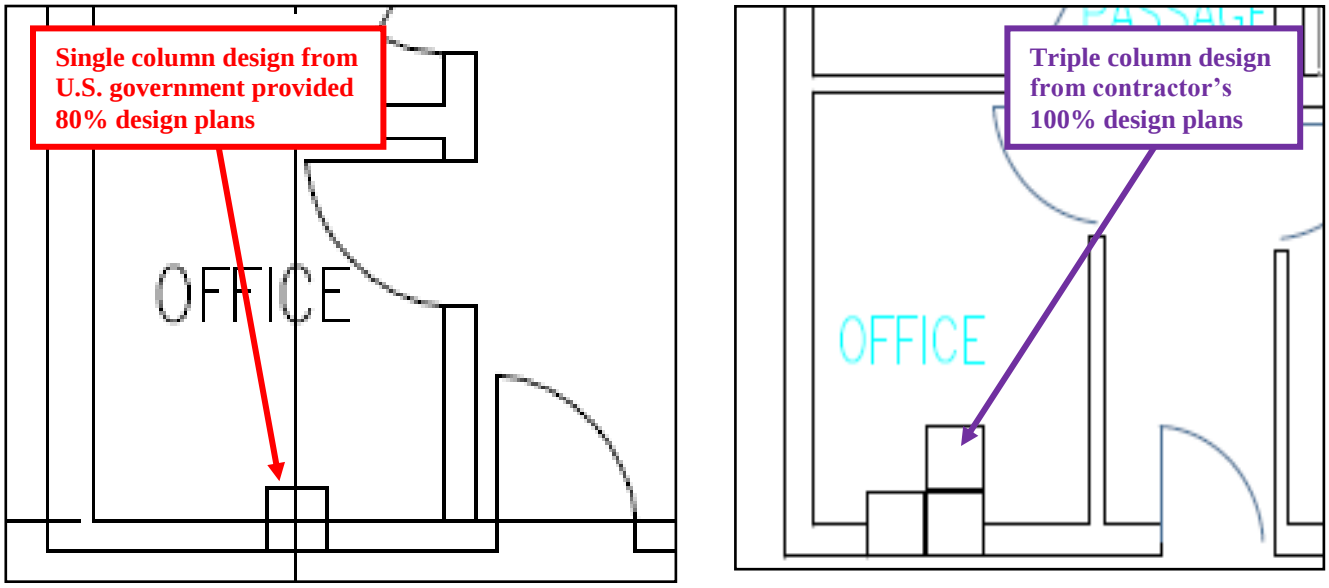


Figure 14. Contractor's overall wastewater treatment plant schematic drawing (Courtesy of GRS)

Building structure plans

The 80% and 15% design drawings for Phases I and II contain general structural information and an overall framing concept. The contractor's designs provided additional structure plans and details, including specific information regarding beam, column, expansion joint locations, and framing details. The general construction of the hospital building and ancillary structures consists of reinforced concrete frame with concrete masonry unit infill. The design accommodates interior reinforced concrete shear walls to resist lateral loads.

The design drawings include a structure layout with additional columns to accommodate expansion joints in the building. While the floor plans were adjusted to accommodate the additional columns, there appeared to be spatial conflicts in several of the rooms. For example, Figure 15 is the original floor plan (80% design), which allocated a 0.5 m x 0.5 m column in this office; while Figure 16 is the contractor's re-design, which added the expansion joint and two additional 0.5 m x 0.5 m columns for the same office. Although the contractor made the office larger to compensate for the undesirable use of space, the additional columns render the office less efficient and aesthetic than if the floor plan was modified to place the columns in less obtrusive locations. SIGIR observed this in several locations.



Figures 15 and 16. The contrast between the 80% design single column configuration (left) and the contractor's triple column configuration (right). The triple column configuration is less efficient space wise and less aesthetically pleasing. (Courtesy of GRS)

Building architectural plans

The architectural plans for the project included detailed information regarding building layout, room dimensions, space planning, and finishes. The contractor-generated design plans provided finalized versions of the facility, including a comprehensive design. The facility appeared to be laid out in a sensible manner with general areas of the hospital grouped together by function. Patients will be presented with a reception/registration area and an adjacent waiting area immediately when entering the main hospital building. The contractor adequately planned pedestrian circulation throughout the main hospital according to use. For example, surgical suites have clear access between both pre-op and post-op areas; while the maternity

ward is located in an area with direct access to facilities for performing Caesarean sections.

Technical specifications

The SOW provided the contractor with detailed technical specifications covering all items and materials to be incorporated into the project. The SOW required conformity to the following codes and standards for the design and construction specific to each trade and category:

- American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 15 (Safety code for Mechanical Refrigeration Rooms)
- ASHRAE Handbook of Applications/Health Care Facilities, 2003 Edition
- International Mechanical Code, 2003 Edition
- National Fire Protection Association (NFPA) 90A (Installation of Air Conditioning and Ventilation Systems)
- NFPA 90B (Installation of Warm Air Heating and Air Conditioning Systems)
- NFPA 101 (Life Safety Code, 2000 Edition)
- NFPA 99 (Standard for Healthcare Facilities)
- International Electro-technical Association
- International Code Council Electrical Codes
- International Building Code

In addition, the contractor must identify and comply with all applicable Iraqi federal, state, and local statutes.

Site Assessment

On 8 January 2009, SIGIR performed an on-site assessment of the MSH project. Two GRS AAO project engineers accompanied SIGIR during the site visit. Due to security concerns, the time allotted for the site visit was approximately 60 minutes. In addition, access to the security gate was restricted by the security escorts due to the potential of unexploded ordnance in the area. Consequently, SIGIR performed an expedited assessment of the areas available; therefore a complete review of all work completed was not possible.

SIGIR observed various contractor personnel performing work at the site. The primary work being performed was construction of concrete formwork and preparation for concrete placement.

Project significantly behind schedule

At the time of the site visit, the project was significantly behind schedule. According to the contract, the contractor had 550 days from the notice to proceed to complete each phase of the project. The GRS AAO issued the Phase I and II NTPs on 21 September 2007 and 6 March 2008; therefore, the contractor needed to complete Phase I by 24 March 2009 and Phase II by 7 September 2009. According to project file documentation, volatile security conditions in and around the Al Amarah area contributed to the project's slow progress. For example, the U.S. military and Iraqi military conducted kinetic operations in June 2008; while security incidences, such as vehicle borne explosive devices, plagued the area throughout June and July 2008. Kinetic operations and security incidences restricted the ability of workers to gain access to the project site, which resulted in work stoppages.

While security concerns did extend the project schedule, GRS AAO representatives determined that the contractor was the primary reason for the schedule slippage. On 13 December 2008, GRS issued a letter of concern formally notifying the contractor the project was behind schedule, which was "unacceptable" and required the contractor to "correct it immediately."

According to the GRS documentation, as of January 2009, Phases I and II of this project were each listed as 26% complete. SIGIR's site visit on 8 January 2009 concluded neither phase of the project was close to 26% complete. SIGIR estimated the project to be approximately 10-15% complete. The local PRT visited the project site in May 2009, and after discussions with GRS representatives, stated that the project's completion date has slipped to "December 2009, or after."

Contractor had not significantly increased number of on-site workers

Concerned about this project's lack of progress, the U.S. Ambassador visited the site in December 2008. According to GRS AAO representatives, the U.S. Ambassador was concerned that the small number of contractor personnel on site would not be sufficient to complete the project in a timely manner. The U.S. Ambassador counted 10 workers on site at the time of his visit. The contractor subsequently agreed to increase the size of his workforce in an effort to expedite the completion of the project.

SIGIR's site visit, which occurred approximately one month after the U.S. Ambassador's visit, documented roughly 25 workers on site. While the number of workers on site had more than doubled, it is still not adequate to construct the project in a timely manner.

Perimeter Security Wall

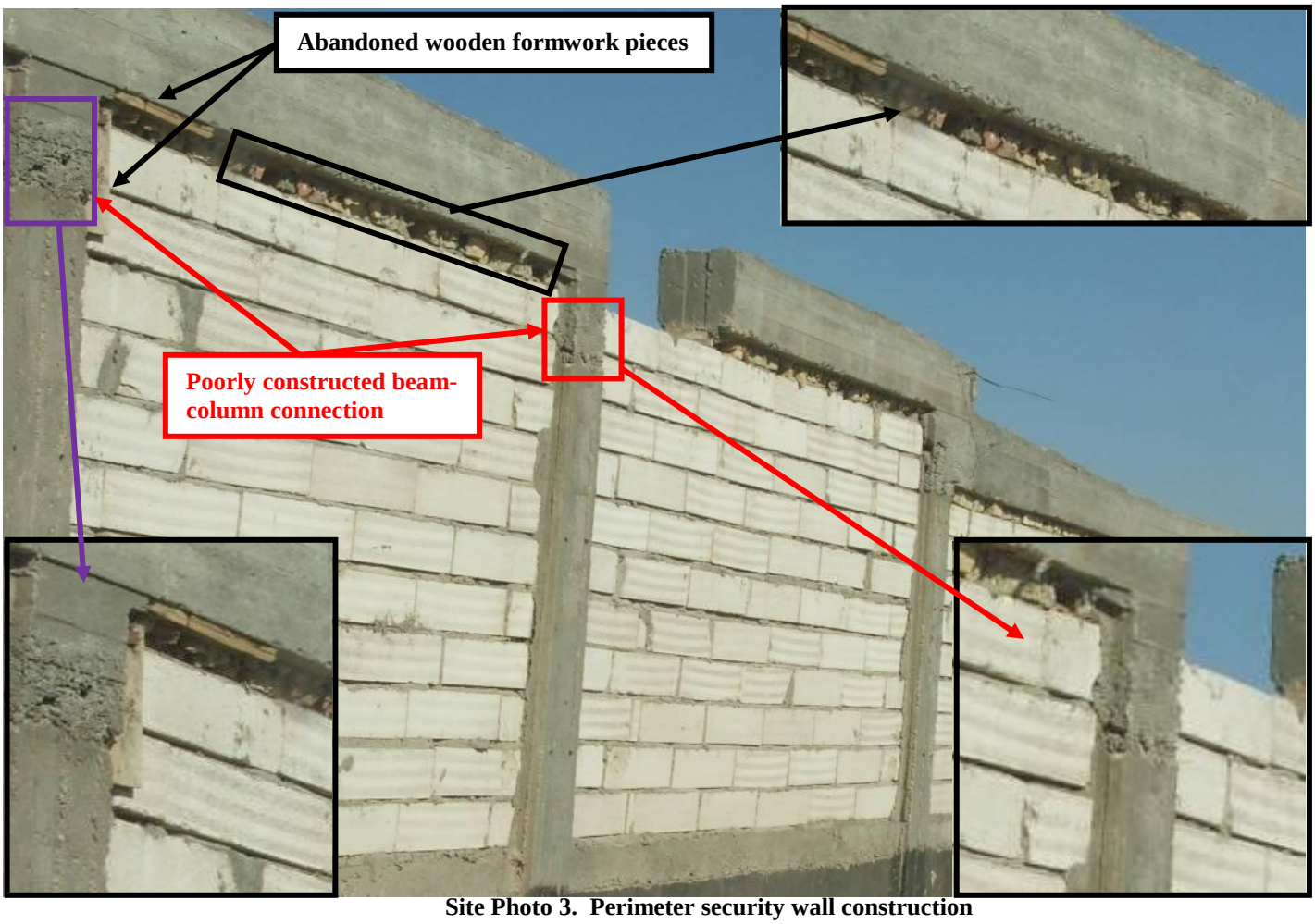
The SOW required a brick perimeter wall 2 m high. SIGIR observed the completed perimeter wall, which consisted of a reinforced concrete frame in filled with brick masonry (Site Photo 3). The military security escort denied SIGIR access to the wall due to the possibility of unexploded ordnance; therefore, SIGIR had to assess the quality of work from a distance of approximately 50 feet.

The security wall appeared to be poorly constructed. For instance, the contractor did not properly construct the haunches for the reinforced concrete beams along the top of the wall. Since the wall beams do not function as significant load bearing members, this is mostly a cosmetic issue, however, the inability of the contractor to construct this connection on this relatively simple part of the project calls into question his ability to adequately construct the considerably more difficult beam-column connections for the main hospital structure. Failure to construct adequate beam-column connections for the primary structural members of the hospital may compromise the lateral stability of the structure. Lack of lateral stability increases the likelihood of structural failure and/or collapse under seismic or wind loading. In addition, a gap existed between the last row of bricks and the concrete beam, which had to be filled with raw materials found on site. Further, the contractor left pieces of wooden formwork in the wall, which not only demonstrates poor practices by the contractor, but more importantly over time the wooden pieces will rot and could adversely affect the integrity of the wall.

Finally, SIGIR previously mentioned in the *Project Design* section of this report that the contractor's design called for waterproofing the base of the wall. At the time of the site visit, the base of the wall had already been backfilled; therefore, SIGIR could not determine if the contractor constructed the wall as designed. However, if the contractor did waterproof the base of the wall without the integration of subsurface drainage behind

the wall, there will be a buildup of hydrostatic pressure against the wall. A buildup of hydrostatic pressure, over time, could result in a reduction of the wall's strength, leading to eventual failure.

At the time of the site visit, the perimeter wall appeared adequate as a deterrent to anyone attempting to unlawfully enter the compound; however, the concerns identified by SIGIR regarding the wall's construction will ultimately affect the wall's long term sustainability.



Site Photo 3. Perimeter security wall construction

Reinforced Concrete Columns and Walls

SIGIR observed completed and partially completed first-story reinforced concrete columns and walls. The partially completed and constructed columns and walls revealed some potential concerns regarding the preparation of the reinforcing steel prior to pouring. For example, in some areas, the reinforcing steel had a coating of cement, most likely left as residue from previous pours (Site Photo 4). The presence of this coating will interfere with the bond between the reinforcing steel and the final concrete pour. Any reduction in bond strength between the concrete and the steel reduces the composite action in the member, which results in a reduction of the overall member strength.

Due to time limitations on site, SIGIR did not have the opportunity to analyze the reinforcing steel inside the formwork to determine if this issue was being rectified prior to concrete pouring operations.

Site Photo 4. Cement coating on reinforcing steel

In addition, SIGIR noted that the reinforcing configuration used in the construction of the reinforced concrete columns varied from the configuration specified in the design drawings. Figure 17 clearly illustrates the difference between the design drawing and actual construction of the reinforcing configuration. The design drawing required three separate pieces of reinforcement bar along with two ties (primary and intermediate). The primary ties a steel bar around the perimeter of the vertical reinforcement bars; while the intermediate ties a steel bar from the middle reinforcement bar of one side to the other. However, the contractor opted to use four vertical pieces of reinforcement bar along with a primary tie around the perimeter.

In order to more clearly illustrate the difference in the design versus actual construction, Figure 17 is the reinforcement configuration from the design drawings; while Figure 17 and Site Photo 5 document the actual construction performed by the contractor.

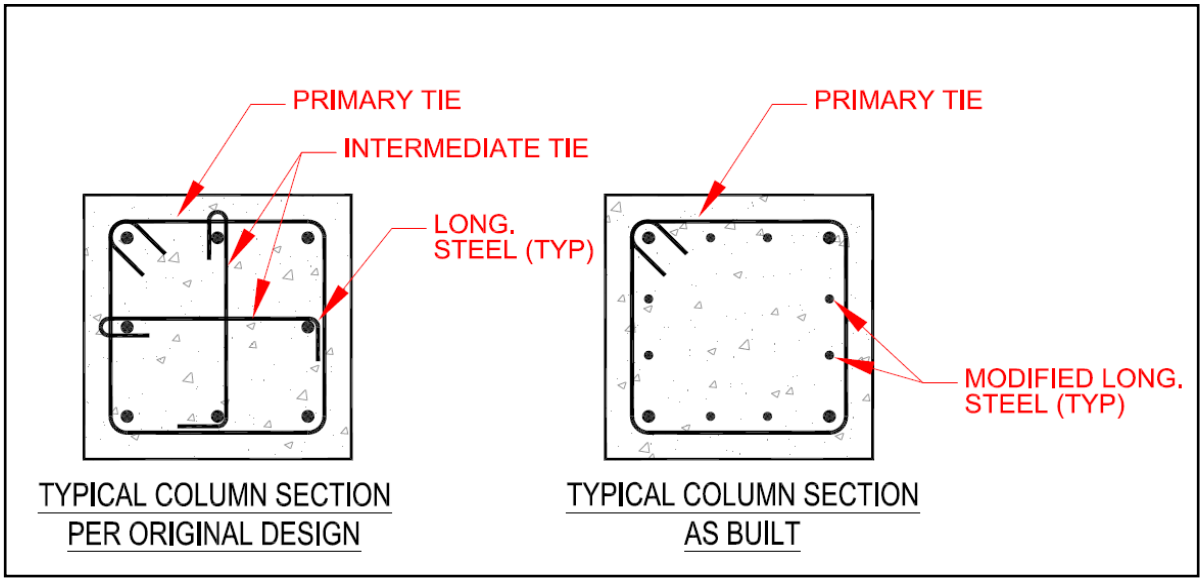


Figure 17. Comparison of typical design column section versus column as constructed

Site Photo 5. Example of constructed column section

After reviewing the design drawings, it appeared the contractor referenced the Iraqi Building Code Requirements for Reinforced Concrete (IBCRRC). Specifically, IBCRRC, section 10.6.5.3 states:

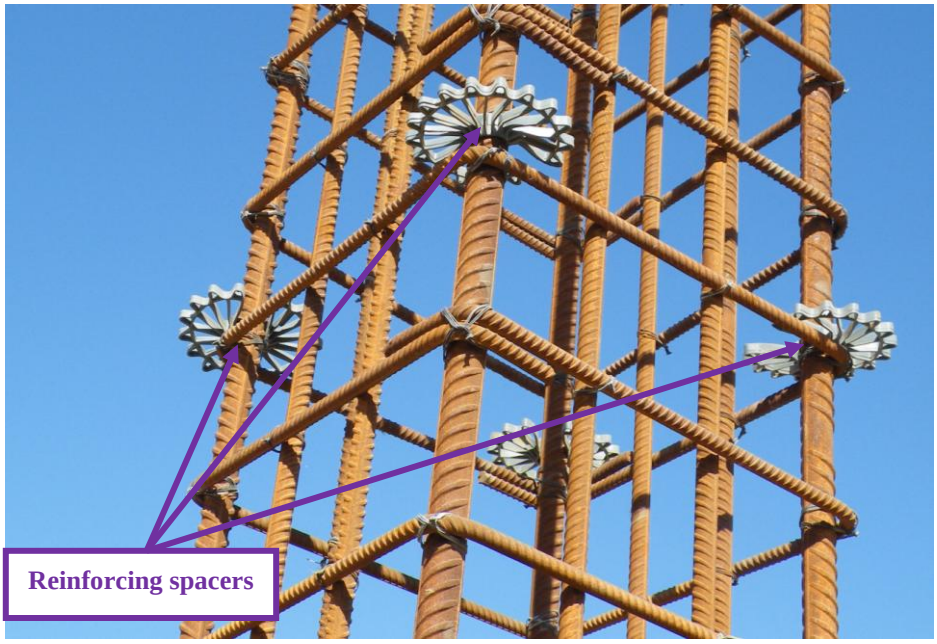
> *"Ties shall be arranged such that every corner and alternate longitudinal bar shall have lateral support provided by one corner of a tie with an included angle of not more than 135 degree and no bar shall be farther apart than 150 mm clear on each side along the tie from such a laterally supported bar. Where longitudinal bars are located around the perimeter of a circle, a complete circular tie may be used."*

IBCRRC Section 10.6.3 provides a waiver for the lateral reinforcing requirements if:

> "*Lateral reinforcement requirements of section 10.6 may be waived where tests and structural analysis show that adequate strength and feasibility of construction can be achieved*."

Since the contractor did not construct the reinforcing configuration according to its own design drawings, SIGIR reviewed the project file for the necessary waiver. The project file lacked any documentation indicating tests and/or structural analysis of the columns had been performed to qualify for a waiver from the use of lateral reinforcing of the columns.

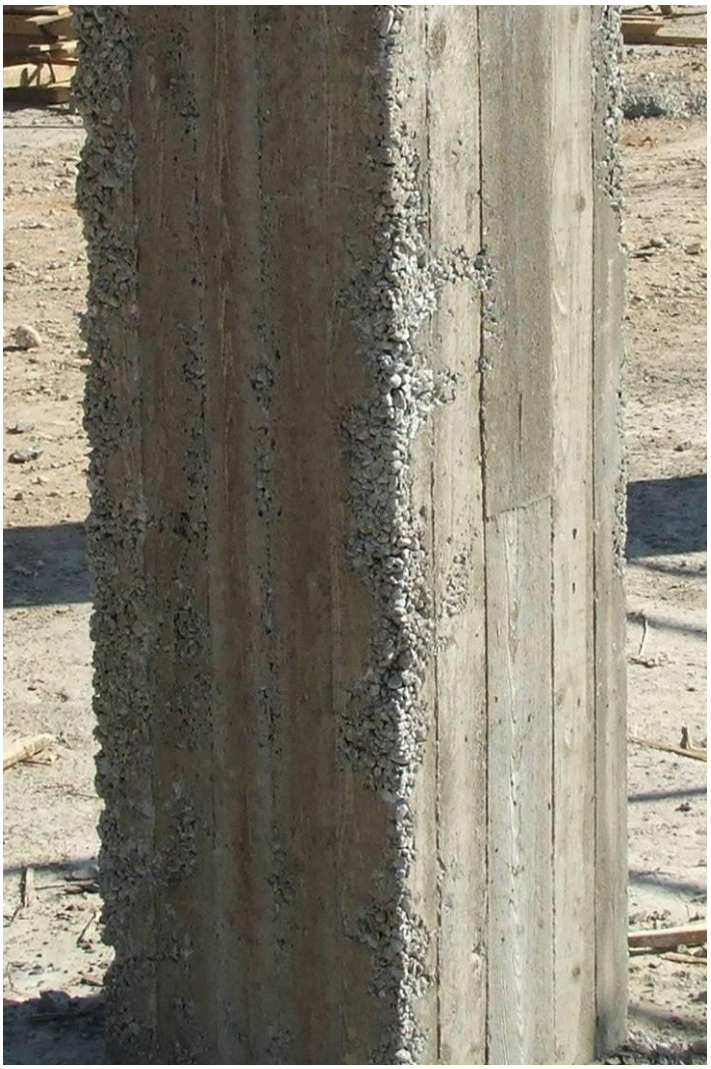
Upon review of the reinforcing steel for the columns, SIGIR noted a wheel type of spacer used in the construction of the reinforcing cage (Site Photo 6). In general, the use of spacers to maintain adequate concrete cover over the reinforcing steel is a good construction practice. However, the configuration of the spacers SIGIR observed may prove to be problematic. Specifically, the contractor utilized spacer with radial spokes between the reinforcing bars and the outer edge of the spacer. The distance between the radial spokes appeared to be smaller than the maximum possible dimension of the aggregate in the concrete mix. During pouring operations, the spokes may become clogged, preventing concrete from completely filling the corners of the column below the spacer, which would result in voids and/or honeycombing at the corners of the columns.



Site Photo 6. Column reinforcing cage and form spacers

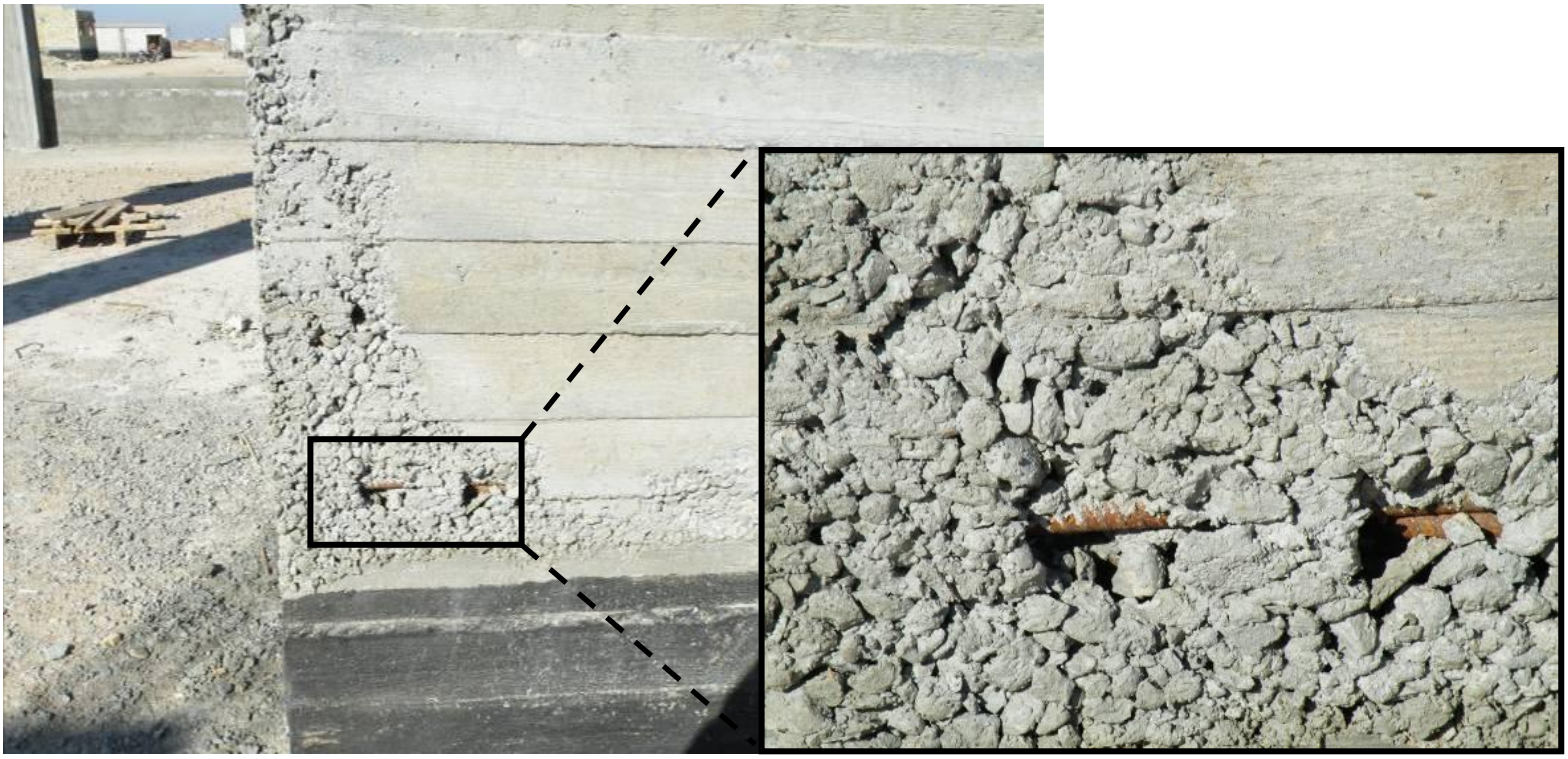
Honeycombing

SIGIR identified several examples, from slight to moderate to severe, of honeycombing of the reinforced concrete members (Site Photos 7 and 8). This construction deficiency appeared to be most prevalent at construction joints between successive pours and along the corners of the reinforced concrete members.



Site Photos 7 and 8. Typical examples of slight to moderate concrete honeycombing in columns

Due to time limitations on site, SIGIR could not assess the extent and severity of the honeycombing, which may require limited destructive testing to ascertain. However, SIGIR did observe, in at least one location, exposed primary reinforcing steel (Site Photo 9). The full extent of the honeycombing should be assessed and appropriate remedial measures taken based upon the impact to each member.



Site Photo 9. Example of severe concrete honeycombing (including exposed reinforcement bar)

Contractor attempts to correct honeycombing problems

SIGIR noticed several instances where the contractor attempted to repair some of the honeycombed areas with low viscosity epoxy (Site Photo 10). Since the extent and severity of the honeycombing could not be ascertained, it is unclear if this is the appropriate repair method for these construction defects.

Site Photo 10. Attempted repair of honeycombing utilizing low viscosity epoxy

However, in most instances that SIGIR observed, this method appeared to be inadequate. For example, the contractor's repair attempt did not achieve complete infill of the visible void areas, and it is reasonable to assume that the epoxy did not reach the subsurface voids in the concrete.

Typically when low viscosity epoxy is used, the application method is pressure injection into the area to be repaired. This method entails the use of an injection pump, nozzle, and fitting to place the epoxy, under pressure, into the void area; however, SIGIR did not observe any of the required equipment at the site. In addition, adequate provisions must be made to seal the surface and force the epoxy resin into all subsurface voids.

The contractor's repair method appeared to be surface application, which will not effectively fill all, if any, subsurface voids. It also appeared to be particularly ineffective in applications involving repair of a vertical concrete surface.

Hospital Foundation Construction

At the time of the site visit, the foundation backfill had already been performed over a significant portion of the project site. Consequently, SIGIR was only able to inspect limited areas of the foundation (Site Photo 11).

Site Photo 11. Foundation prior to backfill

At the time of the site visit, backfilling operations were not taking place. SIGIR noted a lack of visible compaction layers at the edge of fill, which indicates the potential for inadequately compacted backfill (Site Photo 12).

Site Photo 12. Edge of backfill over foundation

SIGIR did not observe any watering equipment available on site, nor did it appear that the contractor was wetting the soil prior to compaction in order to obtain the optimum moisture content. Failure to obtain proper compaction could potentially result in cracking and/or settlement of the ground floor concrete slab.

SIGIR examined the footings and identified a series of miss-drilled dowel holes surrounding an epoxy anchored dowel pin (Site Photo 13). The close proximity of the holes to the anchored dowel has resulted in reduced strength at this connection. However, since this dowel is one in a series of several dowels along the face of the footing, the impact of the weakened connection to the strength of the overall structure appeared to be minimal.

Site Photo 13. Multiple holes surrounding epoxy anchored dowel

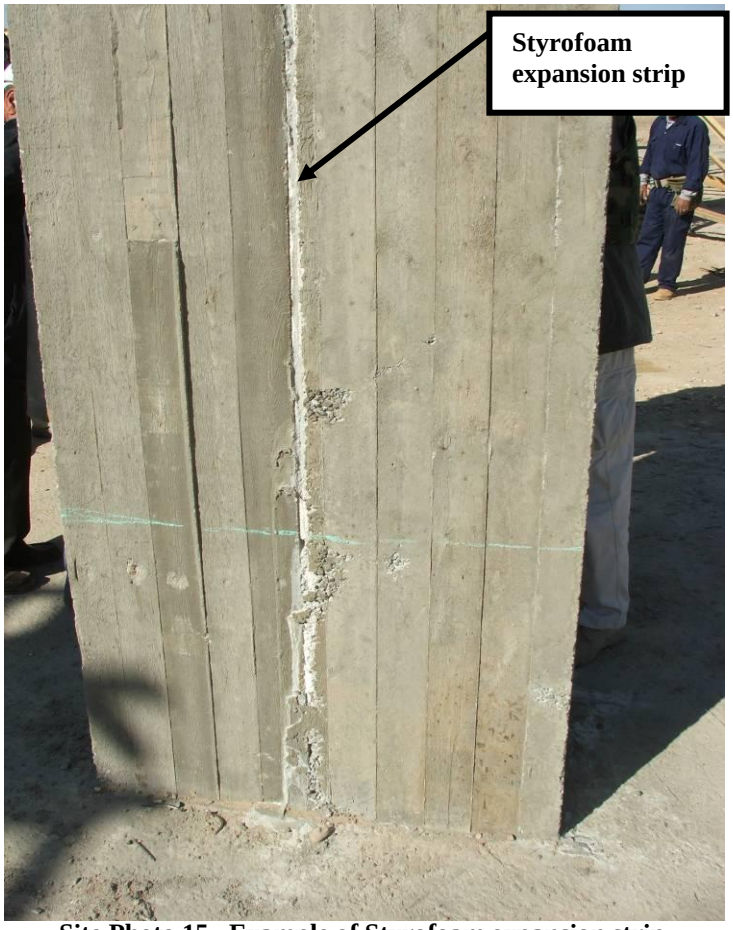
General Observations

Hospital Building

SIGIR noted that in several locations double, and in one case, triple columns were being constructed (Site Photo 14). These columns were not identified on the original URS Corporation drawings for the 80% design for Phase I and a 15% design for Phase II; however, there are indications of multiple columns on the construction contractor's design drawings.

The columns appeared to be constructed from independent concrete pours with Styrofoam expansion strip placed between the columns (Site Photo 15). While not the ideal material to use, Styrofoam will effectively isolate the columns along their length.

Site Photo 14. Double column forming



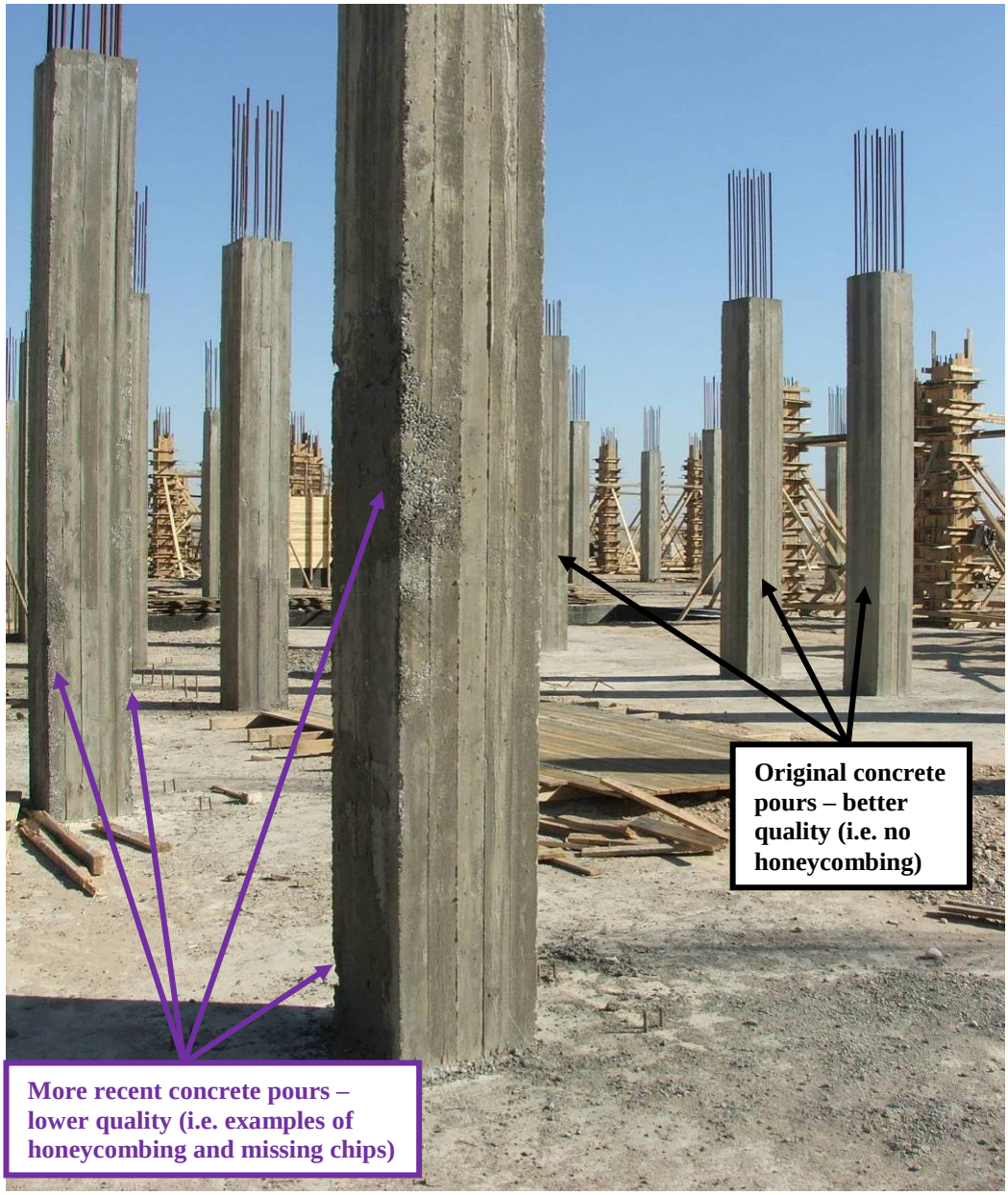
Site Photo 15. Example of Styrofoam expansion strip

GRS AAO representatives stated that the contractor's quality control (QC) personnel were already aware of the concrete quality issues, specifically the honeycombing of the reinforced concrete members. During the site visit, the contractor telephoned SIGIR and stated the concrete issues would be resolved, including tearing out and replacing poorly constructed reinforced concrete members.

GRS AAO representatives stated that they had recently met with the contractor to discuss schedule improvements. Specifically, the contractor was significantly behind schedule and needed to increase his workforce to complete the project. The recent visit by the

U.S. Ambassador reinforced the importance of this project to the U.S. government and the need for the contractor to expedite the completion of the facility for the benefit of the residents of Missan.

SIGIR noticed that the quality of the more recently constructed structural concrete columns was considerably less than some of the original columns (Site Photo 16). There is the possibility that contractor efforts to expedite the project may have led directly to concrete quality issues. For example, in an effort to increase productivity, the contractor probably pulled the column formwork too quickly and failed to adequately clean it prior to the pouring of the next column. Pulling the formwork before it is completely dry and not adequately cleaning it will significantly affect the quality of the next formwork concrete pours. SIGIR mentioned this to the GRS AAO representatives, who agreed that the more recent concrete quality issues could be due to the contractor being asked to follow a more expedited construction schedule.



Site Photo 16. Example of difference in concrete quality from more recent concrete pours

Physician's Residence

Both phases of this project call for a 500 square meter residence to house eight physicians. The contractor's design called for load bearing masonry walls with reinforced concrete framing for the second floor and roof.

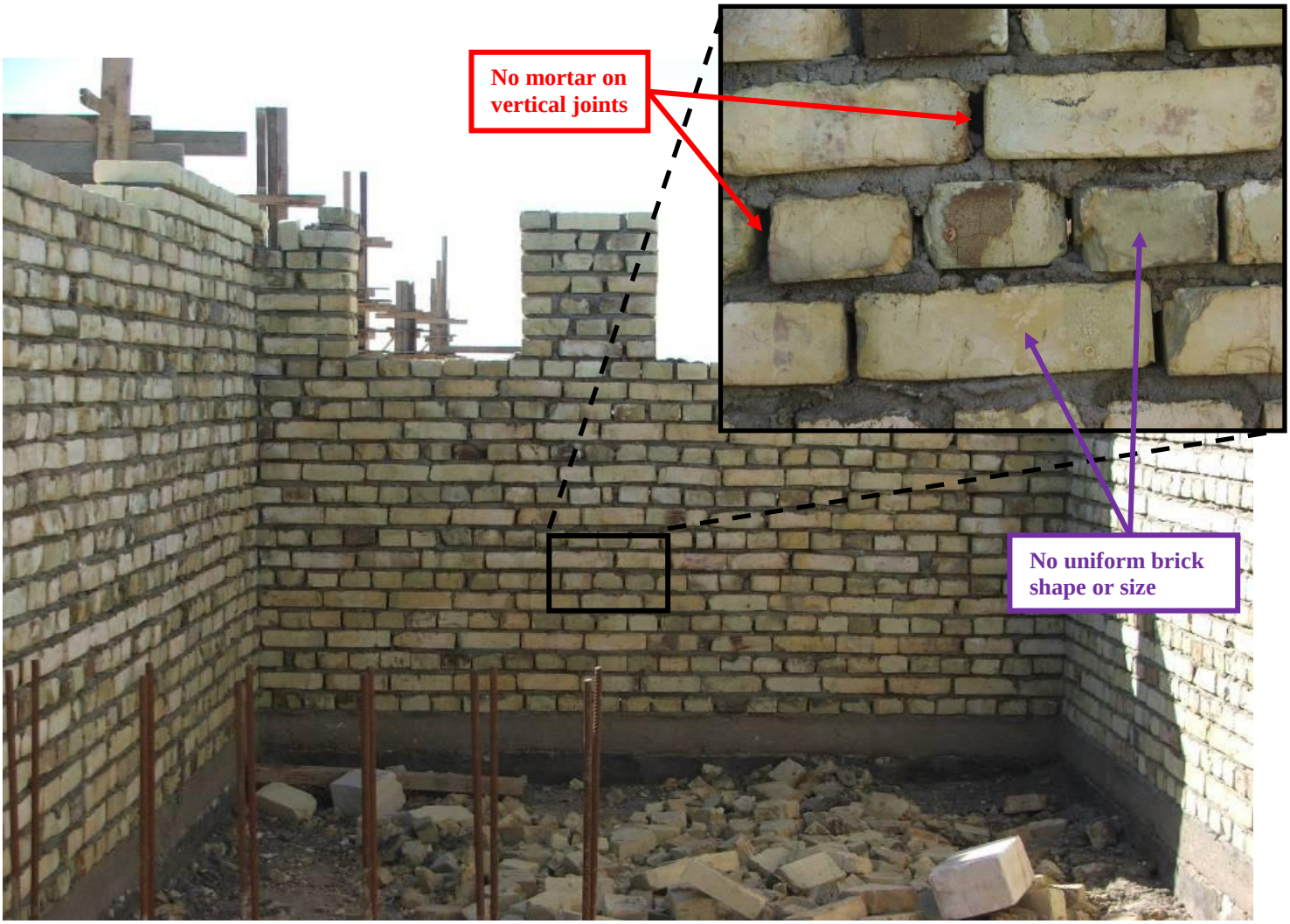
SIGIR visited the partially constructed physicians' residence (Site Photo 17). The contractor had completed the first-story construction of the load bearing masonry wall and was preparing to pour the reinforced concrete lintels. The timber seen in Site Photo 17 is part of the temporary formwork for the lintels. Due to access limitations, the SIGIR inspection team was unable to inspect the interior of the forms or the reinforcing steel for the lintels.

The construction of the brick walls followed local construction techniques and is a two "Wythe English" bond configuration. The bricks are not mortared on perpendicular (vertical sides) nor are they uniform in shape or size (Site Photo 18). While the methods and quality of construction is not comparable to typical European brick masonry, the small size and limited number of stories of this structure should result in relatively low stresses in the brick.

Site Photo 17. Physician's residence

At the time of the site visit, the foundation system was backfilled and could not be inspected. It was noted that the proposed elevation of the interior first floor slab is significantly higher than the adjoining grade. A bond beam was constructed at this level to provide continuity. The exposed portion of the foundation wall had been parged[8] by the contractor and appeared to have been treated with a waterproofing agent.

[8] Applying a thin coat of plaster or mortar to masonry to seal or smooth the surface.



Site Photo 18. Physicians' residence (typical example of brick construction)

Underground Utilities

The contractor had not started any underground utility construction or other site improvements.

Project Quality Management

Contractor's Quality Control Program

Department of the Army Engineering Regulation (ER) 1180-1-6, dated 30 September 1995, provides general policy and guidance for establishing quality management procedures in the execution of construction contracts. According to ER 1180-1-6, "…obtaining quality construction is a combined responsibility of the construction contractor and the government."

The SOW required the contractor to perform all QC throughout the duration of design, construction, installation, and testing and commissioning. The resident/project engineer is responsible for monitoring all QC activities. The contractor must perform factory suggested field tests of primary components and be responsible for all testing at the site.

The contractor submitted a QC plan, which was accepted by the GRS AAO as meeting the standards addressed in ER 1180-1-6.

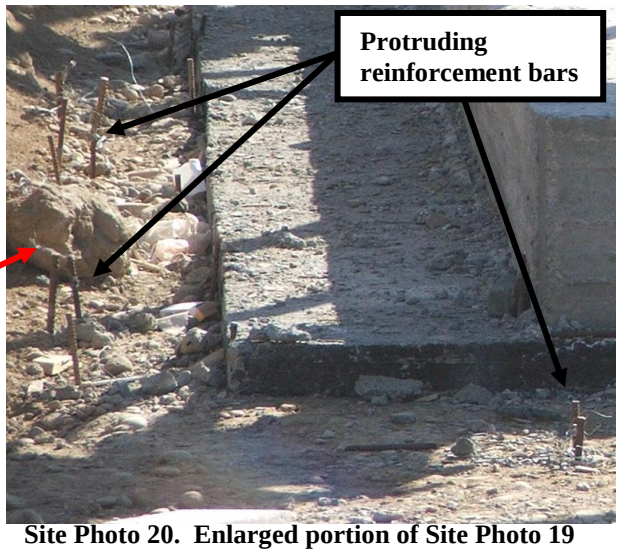
The QC representatives monitored field activities and completed daily QC reports, which presented a brief background on the number of workers on site, the work activities performed on site, and major equipment on site. In addition, the QC representatives periodically supplemented the daily QC reports with photographs reinforcing the information provided in the daily reports. Further, the QC representatives were also present for all significant pours and testing and follow-up on the test results. In several cases, the QC representatives wrote deficiency reports, which documented deviations from the specification requirements, such as compaction results less than specifications required. In addition to documenting deficiencies, these reports also proposed a corrective action for the contractor and recorded the corrective action taken by the contractor.

However, the daily QC reports did not have a section for construction deficiencies identified; consequently, the QC reports failed to document the obvious concrete honeycombing issues that SIGIR identified during the site visit. In addition, the daily QC reports did not mention safety issues at the project site, such as protruding reinforcement bars and nails from broken down formwork boards, which SIGIR observed in numerous locations (Site Photos 19-22). Further, SIGIR noticed the project site cluttered with building materials, which posed tripping hazards to the contractor's crew and any visitors to the site. The protruding reinforcement bars and nails, combined with multiple tripping hazards, increase the likelihood of injury or death. The QC representatives must document all safety hazards for the contractor to correct in order to provide a safe working environment for workers and visitors.

Finally, the GRS AAO questioned the accuracy of the daily QC reports. Specifically, in a letter of concern sent to the contractor, GRS AAO stated the following:

> *"In the visits to the project site by US personnel we have noted that the number of Contractor personnel reported on both the Phase I and Phase II Quality Control Report to be working at the site is higher than the actual Contractor personnel observed at the site."*

Site Photo 19. Examples of protruding reinforcement bar



Site Photo 20. Enlarged portion of Site Photo 19

Site Photo 21. Example of protruding nails

Site Photo 22. Enlarged portion of Site Photo 21

Government Quality Assurance

The USACE ER 1110-1-12 and Project Contracting Office Standard Operating Procedure CN-100 specify requirements for a government quality assurance (QA) program. Similar to the QC program, a crucial oversight technique is presence at the construction site. GRS AAO, which is responsible for the construction of the MSH project, employs local-national Iraqi engineers to serve as QA representatives

visiting the project site daily and writing daily QA reports. Generally, GRS AAO representatives visit project sites frequently to verify contractor's work and perform mentoring activities for the local-national QA representatives. However, since the project site is in a remote location of the province, the opportunity for GRS AAO representatives to visit the project site is limited in both frequency and duration. For example, GRS AAO representatives stated that it takes an entire day to drive from their office to the project site and back; this allows only 30-60 minutes of actual time on site.

Local-national QA representatives monitored field activities and completed daily QA reports, which were reviewed by the GRS AAO project engineer. The reports document the number of workers on site and the work performed for the day. Also, the QA representatives supplement the daily QA reports with detailed photographs that reinforced the information provided in the reports.

While the daily QA reports included a section for construction deficiencies and corrective actions, the QA representatives, similar to the QC representatives, did not document the obvious concrete honeycombing issues that SIGIR identified during the site visit. It appeared that someone must have brought the concrete honeycombing issue to the attention of the contractor because in at least one instance, the contractor attempted to correct the issue (Site Photo 10); however, the daily QA reports are silent on this matter. The honeycombing issue should have been identified in both the QC and QA reports, investigated to determine the root cause(s), and corrective actions implemented to prevent recurrence.

With regard to ensuring a safe work environment, the QA representatives did a better job of identifying and documenting, both in writing and via photographs, the contractor's safety practices. The role of the QA representative was not just to identify any unsafe construction techniques but to also mentor the contractor and workers on a safe working environment. GRS AAO representatives believe this is an important point since this contractor will learn and utilize the improved practices on future construction projects for the GOI.

However, in some instances, the QA representatives were not effective in identifying, documenting, and correcting the contractor's safety practice deficiencies. For example, QA representatives completed a pre-drafted Site Safety Survey Report, which documented the contractor's compliance with specific safety issues, such as workers wearing protective equipment. One report documented that the contractor was doing a "good job" of protecting the work area from protruding reinforcement bars. However, at the time of the site visit, SIGIR noticed numerous protruding reinforcement bars posing a significant safety hazard to the contractor's workers and any visitors to the project site (Site Photo 19). In addition, SIGIR observed numerous tripping hazards at the project site, which combined with the protruding reinforcement bars and nails, poses a significant risk in the likelihood of workplace injury. The QA representatives need to not only document these safety hazards, but also enforce with the contractor the requirement for a safe working environment.

Project Sustainability

This project, as agreed upon by the Missan PRT and MOH, required the U.S. government to fund the construction of the facility and ancillary structures only; the GOI is responsible for providing all equipment (including furniture) and operating the hospital after accepting the project.

Though not required by the contract, the U.S. government provided the GOI with a comprehensive list of all equipment (by department) necessary to fully furnish and operate the hospital. For example, the list provided the following information: department name, room name, room number, room quantity, item quantity, description of each item, manufacturer, and specific model.

The SOW included sustainability elements to assist the Iraqi ministry ultimately responsible for operating this project after turnover. The contract specifications require that the contractor provide and certify warranties in the name of the appropriate ministry for all materials and equipment. In addition, the contractor is required to perform operations and maintenance (O&M) training appropriate to the facilities and equipment installed, constructed, or rehabilitated in the scope of this project along with providing O&M manuals. Specific contract requirements include:

Commissioning and Startup

The contractor will provide an O&M manual, written in Arabic and English, prior to the startup of the facilities. The O&M manual includes standard operation procedures for all equipment and systems, standard maintenance procedures, and recommended spare parts lists for all equipment.

Operations and Maintenance Support

The contract required the contractor to provide O&M support for all facilities and equipment installed, constructed, or rehabilitated in the scope of this project. The contractor will provide this support during the construction, start-up, and commissioning phases of the project and will continue for a period of 180 days following the issuance of the Letter of Project Completion. The contractor will be responsible for repair and maintenance of the facilities, equipment, and devices for a period of 90 days following the issuance of the Letter of Project Completion.

Training

Prior to final acceptance and initial operations, the contractor must conduct site specific O&M training appropriate to the facilities and equipment installed or constructed in the scope of this project. The contractor is responsible for conducting a three-day training session at the site to demonstrate normal O&M procedures for each element of the system to the appropriate technical representatives from the city. The contractor will provide a minimum of three O&M manuals for "Commission Start Up," and all detailed training materials. The contractor must provide a record of the training material, including the list of attendees, the date of training, and topics discussed to the GRS AAO after the completion of training.

In addition, the contractor is responsible for providing the appropriate training for all operators and technicians to allow the hospital staff to conduct long term, routine, and preventive maintenance on all equipment installed. The contractor must develop a comprehensive training package in conjunction with the MOH. The equipment manufacturer's representative or technical experts experienced with the specific equipment and systems provided are responsible for conducting the training.

Joint Engineers Team

GRS AAO employs additional local-national Iraqi engineers under a program referred to as the Joint Engineers Team (JET). These engineers monitor the construction stages of a specific project and, after the construction is completed, work for the ministry as the primary engineers. For example, the Missan Governor recommended three engineers from the PRDC and MOH to work as the JET and will be the primary engineers to operate the hospital when construction is complete. Considering this is the first new hospital built in over 30 years, the JET program is an excellent opportunity to provide the MOH with knowledgeable engineers to assist in operating the hospital.

Warranties

The contract required the contractor to provide and certify warranties in the name of the appropriate ministry of all material or equipments, which include any mechanical, electrical and/or electronic devices, and all operations for 12 months after the final acceptance of the project. In addition, the contractor must provide any other commonly offered extended warranties for material, equipment, and machinery purchased.

Spare Parts

The contract required the contractor to provide individual price lists of spare parts and consumable items that the contractor anticipates will be required during the first two years of operation of the new equipment.

As-built Drawings

Upon completion of each facility under this contract, the contractor must prepare and furnish as-built drawings, which will be a record of the construction as installed and completed. The as-built drawings must include all the information shown on the contract set of drawings, and all deviations, modifications, or changes from those drawings, however minor, which were incorporated in the work, including all additional work not appearing on the contract drawings, and all changes which are made after any final inspection of the contract work.

GRS AAO Actions Taken Since Site Visit

Construction deficiencies – concrete honeycombing

After the site visit, SIGIR discussed the deficiencies identified with the GRS AAO; specifically, the varying degrees of concrete honeycombing and the contractor's inadequate attempts to correct it. GRS AAO representatives and the contractor agreed that limited destructive testing was necessary to determine the full extent and severity of the honeycombing. GRS AAO took immediate action by making multiple visits to the project site to determine the extent and severity of the honeycombing. GRS AAO determined the following:

> *"The contractor performed limited destructive testing. GRS E&C Staff visited the site and indicated thirteen columns; elevator and stairway walls would require demolition and replacement. The Resident Office Deputy Resident Engineer suggested some deficiencies noted to be superficial. The Resident Office Resident Engineer visited the site and concluded after further investigation only five column and the walls require demolition."*

Prior to demolition, the contractor "hired a third party (University of Technology) to investigate the deficiencies." The University of Technology's findings are based on the American Concrete Institute Committee 546 publication. The report recommended the removal of defective concrete and replacement with a suitable repair material. The report noted that care should be exercised in the method of removal to prevent micro-cracking of the substrate resulting in additional areas of unsound concrete. The contractor is directed to repair the area with placement of either "Portland cement mortars, proprietary cementitious materials, or polymer-grouts." The compatibility of the repair material with the existing construction needs to be verified prior to performing the work.

SIGIR reviewed the University of Technology's findings and recommendations and concluded that the recommended strategy is typical for the repair of honeycombed concrete and should be within the capabilities of a competent contractor. However, there is the possibility that incorrect removal techniques could result in additional damage; therefore, close monitoring of the contractor by the on-site QA personnel is required.

Improved quality assurance documentation

GRS AAO representatives, in addition to project construction management, mentor their local-national Iraqi QA engineers on construction techniques, engineering principles, and safety practices. One particular challenge for the local-national QA representatives is writing narrative reports documenting construction deficiencies. After SIGIR's site visit, GRS AAO representatives developed a new QA format and emphasized the importance of documenting construction deficiencies. GRS AAO provided a sample of QA reports written after the site visit. SIGIR reviewed the reports and found them more detailed, especially at identifying and documenting construction deficiencies.

Missan Surgical Hospital -- GOI's Capabilities

At the onset on this project, the GOI pledged its support for the MSH by stating the following:

> *"We would like to inform you and to confirm that our health minister office is ready to provide this hospital with professionally trained staff and all medicine, medical equipment and furniture. Also, we are ready to train service staff for maintenance, operation, and the use of medical equipment as well as provide an annual operating budget."*

However, the recent fluctuation in oil prices has resulted in budget shortages for the GOI, including the funding of projects for the MOH. The U.S. government is concerned about the capability of the current provincial budgets to support the GOI's to purchase of equipment necessary to operate the hospital once construction is complete.

This project will require a significant up front financial investment to procure the extensive medical equipment and furniture required to open the facility to the public; and a large annual investment to provide the necessary resources to operate and sustain the facility such as fuel to run the generators; trained doctors and nurses; salaries for doctors, nurses, and guards; and the necessary pharmaceuticals for patients. In addition, the GOI will need to construct paved roads to the hospital to allow for easier access by the citizens of Al Amarah.

In order to determine the GOI's ability to equip, operate, and maintain this facility after turnover, SIGIR contacted the U.S. government agencies that are directly involved with the construction and turnover of the facility (GRS and ITAO) and the U.S. government

agencies that interface with the GOI on health and governance issues (Health Attaché and PRT).

Fully equipping the hospital

In order to make this facility a "state of the art" hospital, the U.S. government provided the GOI with an extensive list of required furniture, and medical and surgical equipment. The detailed list of equipment ranged from wall-mounted soap dispensers to infant incubators to x-ray equipment. The medical equipment, in most cases, is fairly high-tech and would require a significant amount of lead time to order the item and have it delivered to a remote location in Iraq.

In order to open the facility, all furniture and medical equipment must be purchased, delivered, installed, and tested. The lead time associated with ordering the equipment and having it delivered to Iraq required the GOI fund a budget specifically for this project.

The local Missan PRT visited the project site in early May 2009 and met with the Director General (DG) of Health. The GOI has yet to purchase the required equipment to operate the hospital. In addition, the DG of Health stated that the 2009 budget is thoroughly committed, and that hospital related funding would likely need to be provided from 2010 budget funds.

Opening and operating the hospital

Prior to opening the facility, all furniture and medical equipment will need to be installed and tested. The hospital administrator will then need to perform multiple "dry runs," including mock injuries and surgeries for the newly assembled staff to practice.

In order to operate the hospital once it has been officially opened to the public, the GOI must dedicate resources, both tangible (doctors and nurses) and intangible (salaries for the doctors and nurses, contracts for laundry and food services, diesel fuel for the generators, and pharmaceuticals).

In terms of doctors and nurses, according to Health Attaché representatives, the Missan DG for Health recently stated that physicians from the local hospitals are willing to work at the new hospital. However, this would result in shifting medical professionals from existing hospitals to the new MSH, which confirmed one of the U.S. Ambassador's original concerns that it constituted a "zero-sum game." While the residents of Al Amarah would enjoy the benefits of a new hospital, the number of medical professionals would remain the same. In addition, when the local PRT visited the project site on 2 May 2009, the DG of Health personnel manager stated that the medical professionals in Missan lack modern expertise in most specialized fields. The DG requested the PRT assist with a training program for all doctors scheduled to work at the MSH.

According to Health Attaché representatives, the MSH will also serve as a training facility for a local medical college. The hope is that this facility will help to train additional doctors and nurses who will eventually work at the facility and alleviate the strain of shifting doctors from existing hospitals to cover the shortfall at the MSH. In addition, according to the MOH, due to improved security conditions throughout the country, approximately 25 doctors per week are reportedly returning to Iraq. However, the specific provinces the doctors are returning to cannot be determined; therefore, it is unknown if the Missan province is or will, in the future, benefit from the return of Iraqi doctors.

Sustaining the hospital

To properly sustain the hospital, once completed, the GOI will need a sizeable annual budget dedicated to provide a skilled maintenance crew and ultimately provide the facility with permanent, reliable power.

In addition, the "city development plan" for Al Amarah requires the GOI to spend a significant amount of money to expand the existing city boundaries north around the hospital site area. According to U.S. government representatives, the GOI originally planned to fund housing and infrastructure projects, such as roads directly to the hospital, in an effort to complement the project.

ITAO Actions Taken Since Site Visit

After the 2 May 2009 meeting between the PRT and DG of Health at the MSH project site, ITAO representatives met with representatives from the Health Attaché and PRT to discuss the status of the GOI's ability to equip, operate, and maintain the MSH. The U.S. government needed to determine the GOI's level of commitment for the acceptance and operation of this facility. Specifically, ITAO asked the PRT to determine whether the local DG of Health had the ability and capacity to create a budget to equip, procure, staff, and operate this facility; while the Health Attaché would engage the MOH to emphasize the necessity to plan now to meet its commitments to the MSH.

The budget shortages resulting from the reduction in crude oil prices will continue to impact the GOI's ability to adequately equip, operate, and maintain the MSH. The May 2009 ITAO meeting was a good first step; continued engagement by the U.S. government will have a positive effect on the GOI's efforts to fund and operate this hospital, which represents a substantial investment by American taxpayers in health care for the Missan province.

Conclusions

The assessment determined that:

1. The U.S. government provided the preliminary design (80% for Phase I and 15% for Phase II) to the contractor. The contract's Statement of Work required the contractor to develop the preliminary package into a complete design package. Specifically, the Statement of Work required the contractor to review the preliminary designs and "correct any conflict or deficiency, also provide any missing or required details or drawings."

   SIGIR reviewed the contractor-generated drawings, which contained specific information on the site utilities, site drainage, sewage collection system, and other project features. SIGIR determined that with the exception of two project features, there was adequate information to complete the final design and construct the facility. However, SIGIR did identify several deficiencies, omissions, and areas of concern in the contractor-generated drawings. To deliver a fully functioning and sustainable hospital, the design deficiencies, omissions, and areas of concern need to either be corrected or clarified.

   Currently, this project lacks complete design drawings that show how water will be provided to the hospital and how wastewater from the hospital will be disposed of. SIGIR is concerned about the lack of planning associated with these aspects

of the project, especially for water supply. According to GRS, the current plan is to place the river intake near the intersection of the Tigris and Al Kahla Rivers and then run the water lines to the hospital site. However, this would require the contractor to excavate and lay two pipelines a total of 3.1 kilometers through a significant portion of the city of Al Amarah. SIGIR believes that excavating through the city will be intrusive to the city's residents and will be slow and dangerous work for the contractor. In addition, the design plan sheet for the river intake pump station lacked significant detail to ensure proper construction of the facility.

Similar to the water supply, the design for the wastewater system lacked significant details, such as the alignment and outfall of the sewage leaving the hospital site. The overall schematic drawing of the wastewater treatment plant indicates that the sewage leaving the hospital will be deposited directly into the "main city network nearest manhole" without identifying:

- the exact location and distance to the nearest manhole
- the size, elevation, and condition of the main city network sewer pipe
- whether or not an analysis has been performed to determine if the existing city network system can accommodate the significant additional flow from the hospital

To ensure that sewage does not back up into the hospital, local homes, and streets of Al Amarah, it is important that the network have the capacity to handle the additional flow.

2. During the 8 January 2009 site visit, SIGIR observed that construction work, such as concrete formwork and preparation for concrete placement was ongoing. Due to security concerns, the on-site visit was only 60 minutes, and access to the security wall was restricted to 50 feet because of unexploded ordnance in the area. SIGIR observed construction deficiencies, such as a poorly constructed security wall, areas of reinforcing steel with a coating of cement residue, reinforcing configuration used in the construction of the reinforced concrete columns that varied from the configuration specified in the design drawings, and examples of concrete honeycombing—ranging from slight to severe.

   SIGIR discussed these deficiencies identified with the GRS AAO; specifically, the concrete honeycombing and the contractor's inadequate attempts to correct it. The GRS AAO took immediate action by making multiple visits to the project site to determine the extent and severity of the honeycombing. The GRS AAO Resident Engineer concluded that five columns and the wall required demolition. However, the contractor hired the University of Technology to investigate the concrete issue. The University of Technology's report recommended the removal of defective concrete and replacement with a suitable repair material ("Portland cement mortars, proprietary cementitious materials, or polymer-grouts). SIGIR reviewed the University of Technology's findings and recommendations and concluded that the recommended strategy is typical for the repair of honeycombed concrete and should be within the capabilities of a competent contractor.

3. The contractor's quality control (QC) plan was sufficiently detailed to effectively guide the contractor's quality management program. The contractor submitted a QC plan, which was accepted by the GRS AAO as meeting the standards addressed in Engineering Regulation 1180-1-6 (*Construction Quality Management).* The QC representatives monitored field activities and completed

daily QC reports, which presented a brief background on the number of workers on site, the work activities performed on site, and major equipment on site. However, the daily QC reports did not have a section for construction deficiencies identified; consequently, the QC reports failed to document the obvious concrete honeycombing issues that SIGIR identified during the site visit. In addition, the daily QC reports did not mention safety issues at the project site, such as protruding reinforcement bars and nails from broken-down formwork boards, which SIGIR observed in numerous locations. Further, SIGIR noticed that the project site was cluttered with building materials, which posed tripping hazards to the contractor's crew and visitors to the site. The protruding reinforcement bars and nails, combined with multiple tripping hazards, increase the likelihood of injury or death. Finally, the GRS AAO questioned the accuracy of the daily QC reports. Specifically, in a letter of concern to the contractor, GRS AAO stated the following:

> *"In the visits to the project site by US personnel we have noted that the number of Contractor personnel reported on both the Phase I and Phase II Quality Control Report to be working at the site is higher than the actual Contractor personnel observed at the site."*

Hampered by local area security issues and the project site's remote location, the U.S. government quality assurance (QA) program has not been effective in monitoring the contractor's QC program. GRS AAO employed local Iraqi national QA representatives to monitor field activities and complete daily QA reports, which were reviewed by the GRS AAO project engineer. The daily reports documented the number of workers on site and the daily work performed. However, the daily reports did not document the obvious concrete honeycombing issues SIGIR identified during the site visit. It appeared that someone must have brought the concrete honeycombing issue to the attention of the contractor because the contractor attempted to correct the issue at least once; however, the daily QA reports are silent on this matter. In addition, in some instances, the QA representatives did not enforce proper safety procedures. SIGIR observed numerous protruding reinforcement bars and nails, which posed a significant safety hazard to the contractor's workforce and visitors to the project site.

After SIGIR's site visit, GRS AAO representatives developed a new QA format and emphasized the importance of documenting construction deficiencies. GRS AAO provided a sample of QA reports written after the site visit, which SIGIR found to be more detailed, especially at identifying and documenting construction deficiencies.

4. Sustainability was addressed in the contract requirements. The Statement of Work included sustainability elements to assist the Iraqi ministry ultimately responsible for operating this project after turnover. The contract specifications require the contractor to provide and certify warranties in the name of the appropriate ministry for all materials and equipment. In addition, the contractor is required to perform operations and maintenance training appropriate to the facilities and equipment installed, constructed, or rehabilitated in the scope of this project, along with providing operations and maintenance manuals. Further, the contract required the contractor to provide individual price lists of spare parts and consumable items considered to be essential during the first two years of operation of the new equipment. Upon completion of each facility, the contractor must prepare and furnish as-built drawings, which will be a record of the construction as installed and completed.

Finally, though not required by the contract, the U.S. government provided the GOI with a comprehensive list of all equipment (by department) necessary to fully furnish and operate the hospital, including the department name, room name, room number, room quantity, item quantity, description of each item, manufacturer, and specific model.

5. To date, the MSH project results are consistent with the original project objectives to construct a surgical hospital and associated ancillary facilities for the residents of Al Amarah. However, the lack of detailed design drawings for the water supply and wastewater system threaten the ability of the facility to receive water and dispose of wastewater—essential components of an operational surgical hospital.

   The original project objectives of the U.S. government were to provide the citizens of Al Amarah with a surgical hospital building and associated ancillary facilities only; the GOI is responsible for providing all the medical equipment, furniture, and personnel (i.e. doctors and nurses) necessary to open, operate, and maintain the project. As of May 2009, the GOI has yet to procure any equipment or identify the specialized doctors and nurses needed to staff the MSH. Further, the GOI pledged in August 2007 that in addition to identifying a professionally trained staff, it would "provide an annual operating budget;" however, almost two years later, the GOI has yet to allocate any funding for this project. Specifically, the local Director General (DG) for Health's 2009 budget is "thoroughly committed" with no funding for this project. Any funding for this project would have to be provided from the 2010 budget. The DG for Health requested the U.S. Embassy engage the MOH in order to better focus the MOH on the need to better plan now to meet its commitment to this project. In order to serve the people of Al Amarah, the GOI will be required to provide these valuable assets.

   Finally, the contractor's slow progress and construction deficiencies further delay the completion of this hospital.

Recommendations

SIGIR recommends that the Commanding General, Gulf Region Division of the U.S. Army Corps of Engineers, take these actions:

1. Resolve the design deficiencies, omissions, and areas of concern with the contractor to guarantee that the project is adequately designed.
2. Follow-up with the contractor to ensure that the complete design drawings include water distribution lines from the river intake to the hospital site and wastewater distribution lines from the hospital site to the appropriate sewer line connection.
3. Require the contractor to remove all defective concrete and replace it with a suitable repair material.
4. Require the local national on-site quality assurance representatives to closely monitor and ensure that the contractor removes and replaces deficient concrete.

To protect the U.S. government's investment of approximately $12.7 million, SIGIR recommends that ITAO continue its efforts to coordinate with the Missan PRT, Health Attaché, and GOI to ensure that the MSH will be fully equipped, have trained staff

available, and funding to maintain the operation of the facility once construction has been completed.

Management Comments

SIGIR received comments on the draft of this report from the Gulf Region Division of the U.S. Army Corps of Engineers and the Iraq Transition Assistance Office of the U.S. Embassy-Iraq, concurring with the recommendations in the report. The U.S. Army Corps of Engineers also provided technical comments for clarification. SIGIR reviewed the comments provided by the U.S. Army Corps of Engineers and revised the final report as appropriate.

Evaluation of Management Comments

SIGIR appreciates the concurrences by the U.S. Army Corps of Engineers and U.S. Embassy-Iraq with the draft report's recommendations. Their comments addressed our recommendations and provided additional clarifying information for this final report. As a result, no additional comments are required.

Appendix A. Scope and Methodology

SIGIR performed this project assessment from December 2008 through May 2009 in accordance with the Quality Standards for Inspections issued by the Council of Inspectors General on Integrity and Efficiency. The assessment team included two engineer/inspectors and two auditor/inspectors.

In performing this Project Assessment SIGIR:

- Reviewed documentation to include the following: bill of quantities, notice to proceed, revised Statement of Work, modifications, and quality assurance/quality control reports;
- Reviewed the design package (plans) and photographs documenting construction progress;
- Interviewed Gulf Region South personnel; and
- Conducted an on-site assessment and documented results at the Missan Surgical Hospital in Al Amarah, Iraq.

Due to security concerns, the time allotted for the site visit was approximately 60 minutes. In addition, access to the security gate was restricted by the security escorts due to the potential of unexploded ordnance in the area. Consequently, SIGIR performed an expedited assessment of the areas available; therefore a complete review of all work completed was not possible.

Appendix B. Acronyms

ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
DG	Director General
ER	Engineering Regulation
ESF	Economic Support Fund
GOI	Government of Iraq
GRD	Gulf Region Division
GRS AAO	Gulf Region South, Adder Area Office
IBCRRC	Iraqi Building Code Requirements for Reinforced Concrete
ITAO	Iraq Transition Assistance Office
JET	Joint Engineers Team
km	kilometer
m	meter
m^2	square meters
MOH	Ministry of Health
MSH	Missan Surgical Hospital
NET	National Embassy Team
NFPA	National Fire Protection Association
NTP	Notice to Proceed
O&M	Operations and Maintenance
PRDC	Provincial Reconstruction and Development Committee
PRT	Provincial Reconstruction Team
QA	Quality Assurance
QC	Quality Control
SIGIR	Special Inspector General for Iraq Reconstruction
SOW	Statement of Work
USACE	U.S. Army Corps of Engineers

Appendix C. GRD Comments on Draft Report

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
GULF REGION DIVISION
BAGHDAD, IRAQ
APO AE 09348

REPLY TO
ATTENTION OF

CEGRD-CG

18 June 2009

MEMORANDUM FOR Special Inspector General for Iraq Reconstruction, US Embassy Annex II, Room 1013, APO AE 09316

SUBJECT: SIGIR Draft Project Assessment Report – Missan Surgical Hospital Under the Economic Support Fund, Missan, Iraq (SIGIR PA-08-167 and PA-08-169)

1. The Gulf Region Division (GRD) reviewed the subject draft report and concurs with the recommendations. GRD provides its response to the recommendations and additional comments for clarity and accuracy in the enclosure.

2. Thank you for the opportunity to review the draft report and provide our written comments for incorporation in the final report.

3. If you have any questions, please contact Mr. Robert Donner at (540) 665-5022 or via email Robert.J.Donner@usace.army.mil.

Encl

CLAUDE V. FULLER, JR.
Colonel, USAF
Deputy Commander

Appendix C. GRD Comments on Draft Report

GULF REGION DIVISION
COMMAND REPLY
to
SIGIR Draft Project Assessment Report – Missan Surgical Hospital Under the Economic Support Fund
Missan, Iraq
SIGIR Report Number 08-165 & 0167
(Project Numbers PA-08- 165 & 167)

SIGIR recommends the Commanding General, Gulf Region Division of the U.S. Army Corps of Engineers:

Recommendation 1. Resolve the design deficiencies, omissions, and areas of concern with the contractor to guarantee that the project is adequately designed.

GRD Response. Concur. This is a design-build contract. To date, Gulf Region South (GRS) agrees with the overall design and believes the contractor can continue working while other aspects and coordination issues are being resolved. GRS reviews and comments on the reasonableness of additional design information received before that phase of construction begins.

Recommendation 2. Follow-up with the contractor to ensure that the complete design drawings include water distribution lines from the river intake to the hospital site and wastewater distribution lines from the hospital site to the appropriate sewer line connection.

GRD Response. Concur. GRS frequently meets with the contractor. The contractor is currently coordinating with the local municipality for both water and electrical requirements. Based on current progress of construction, this is the appropriate timeframe for the contractor to work coordination with local entities. The contractor must be allowed adequate time so that construction activities are properly coordinated.

Recommendation 3. Require the contractor to remove all defective concrete and replace it with a suitable repair material.

GRD Response. Concur. GRS will require the contractor to remove all defective concrete and replace it with a suitable repair material. The project manager, the Contracting Officer, and all related Contracting Officer Representatives will work to ensure this happens.

Enclosure

Appendix C. GRD Comments on Draft Report

Recommendation 4. Require the local national on-site quality assurance representatives to closely monitor and ensure that the contractor removes and replaces deficient concrete.

GRD Response. Concur. GRS will require the local national on-site quality assurance representatives to closely monitor and ensure that the contractor removes and replaces deficient concrete. The project manager, the Contracting Officer, and all related Contracting Officer Representatives will work to ensure this happens.

GRD provides the following comments for clarity and accuracy.

1. Draft Report, page 12, last paragraph. In addition, both the U.S. government and the contractor's designs called for only two guard houses (one at each entrance/exit to the hospital - Figure 9).

Command Comment. This paragraph implies increased security measures be included in the design. Based on coordination efforts with the Minister of Health, the security measures in the design are appropriate for a hospital.

2. Draft Report, page 14, fourth paragraph. In addition, GRS provided two design drawings for the raw water intake; both designs dated 30 April 2008.

Command Comment. SIGIR received drawings GRS had on file during their visit on 8 January 2009. GRS subsequently provided updated drawings received after the site visit. The contractor is coordinating with local entities regarding utility access.

3. Draft Report, page 15, second paragraph. In addition, according to GRS AAO, no assessment has been performed of the water source to determine the annual and monthly breakdown of water depth and water quality analysis.

Command Comment. GRS is working with the contractor as they coordinate with the municipality in acquiring an annual and monthly breakdown of water depth and water quality analysis.

Appendix D. ITAO Comments on Draft Report

Embassy of the United States of America
Baghdad, Iraq

June 17, 2009

Angelina Johnston and Kevin O'Connor
SIGIR Assessments
SIGIR Baghdad

Ms. Johnston and Mr. O'Connor:

Thank you for the opportunity to respond to the draft report on Missan (sic) Surgical Hospital (MSH), SIGIR PA-08-165 and SIGIR PA-08-167. The draft recommends that ITAO continue its coordination effort to ensure that the MSH is properly staffed, equipped, funded and maintained. As noted on page seven of the draft report, the Ministry of Health (MoH) accepted all responsibility for these tasks in its letter of sustainment dated 12 August 2007. ITAO cannot guarantee actions to be performed by the MoH, however, ITAO will make every effort to protect the U.S. government's investment by continuing to coordinate with the Missan PRT, Health Attaché, and GOI to encourage the MoH to fulfill its commitments regarding the MSH.

Sincerely,

Karen Aguilar
Director - ITAO

Encl

Appendix E. Report Distribution

Department of State

Secretary of State
- Senior Advisor to the Secretary and Coordinator for Iraq
- Director of U.S. Foreign Assistance/Administrator, U.S. Agency for International Development
  - Director, Office of Iraq Reconstruction
- Assistant Secretary for Resource Management/Chief Financial Officer, Bureau of Resource Management

U.S. Ambassador to Iraq
- Director, Iraq Transition Assistance Office
- Mission Director-Iraq, U.S. Agency for International Development

Inspector General, Department of State

Department of Defense

Secretary of Defense
Deputy Secretary of Defense
Under Secretary of Defense (Comptroller)/Chief Financial Officer
- Deputy Chief Financial Officer
- Deputy Comptroller (Program/Budget)

Deputy Assistant Secretary of Defense-Middle East, Office of Policy/International Security Affairs
Inspector General, Department of Defense
Director, Defense Contract Audit Agency
Director, Defense Finance and Accounting Service
Director, Defense Contract Management Agency

Department of the Army

Assistant Secretary of the Army for Acquisition, Logistics, and Technology
- Principal Deputy to the Assistant Secretary of the Army for Acquisition, Logistics, and Technology
- Deputy Assistant Secretary of the Army (Policy and Procurement)
- Commanding General, Joint Contracting Command-Iraq/Afghanistan

Assistant Secretary of the Army for Financial Management and Comptroller
Chief of Engineers and Commander, U.S. Army Corps of Engineers
- Commanding General, Gulf Region Division
- Chief Financial Officer, U.S. Army Corps of Engineers

Auditor General of the Army

U.S. Central Command

Commanding General, Multi-National Force-Iraq
- Commanding General, Multi-National Corps-Iraq
- Commanding General, Multi-National Security Transition Command-Iraq
- Commander, Joint Area Support Group-Central

Other Federal Government Organizations

Director, Office of Management and Budget
Comptroller General of the United States
Inspector General, Department of the Treasury
Inspector General, Department of Commerce
Inspector General, Department of Health and Human Services
Inspector General, U.S. Agency for International Development
President, Overseas Private Investment Corporation
President, U.S. Institute of Peace

Congressional Committees

U.S. Senate

Senate Committee on Appropriations
Senate Committee on Armed Services
Senate Committee on Foreign Relations
Senate Committee on Homeland Security and Governmental Affairs

U.S. House of Representatives

House Committee on Appropriations
House Committee on Armed Services
House Committee on Oversight and Government Reform
House Committee on Foreign Affairs

Appendix F. Project Assessment Team Members

The Office of the Assistant Inspector General for Inspections, Office of the Special Inspector General for Iraq Reconstruction, prepared this report. The principal staff members who contributed to the report were:

Angelina Johnston

Kevin O'Connor

Shawn Sassaman, P.E.

Todd Criswell, P.E.