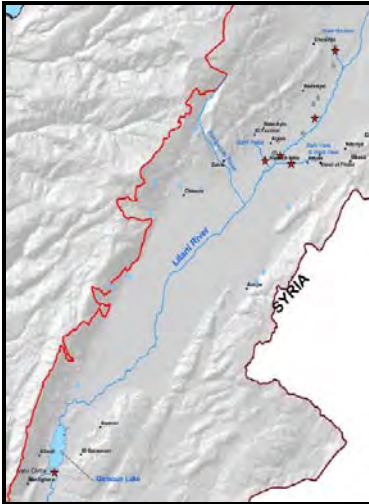




**USAID | LEBANON**  
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## Small Village Wastewater Treatment Systems- Phase II Project for the Upper Litani River Basin in Lebanon

USAID Contract #: 268-C-00-05-00066-00



# Final Report

October 2012



**CDM  
Smith**

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## Abbreviations

| Abbreviation      | Definition  |
|-------------------|---|
| #                 | number  |
| %                 | percent   |
| \$                | United States dollar  |
| approx            | approximate(ly)   |
| Bldg.             | building  |
| BOD <sub>5</sub>  | biochemical oxygen demand (5 day)   |
| BOQ               | Bill of Quantities  |
| CC                | contract change   |
| CCI               | CDM Constructors Inc.   |
| CDM/DAR           | CDM International Inc. in association with Dar Al-Handasah Consulting Engineers |
| conc.             | concrete  |
| COD               | Chemical Oxygen Demand  |
| CQC               | contractor's quality control  |
| d                 | day   |
| dia.              | diameter  |
| DIP               | ductile iron pipe   |
| DLC               | Defects Liability Certificate   |
| DLP               | Defects Liability Period  |
| Ea.               | each  |
| ED                | Engineer's Decision   |
| ED/CMC            | engineering design / construction management contract                           |
| EMCO              | EMCO Engineering LTD  |
| ERP               | elevation reference point   |
| ex                | existing  |
| FM                | force main  |
| HVAC              | heating, ventilation and air conditioning                                       |
| Inc.              | incorporated  |
| JV                | joint venture   |
| L/G               | Letter of Guarantee   |
| km                | kilometer   |
| lm                | linear meters   |
| LMU               | Lake Municipalities Union   |
| lps               | liters per second   |
| LRA               | Litani River Authority  |
| m                 | meters  |
| m <sup>3</sup>    | cubic meter(s)  |
| m <sup>3</sup> /d | cubic meters per day  |
| MCC               | motor control center  |
| mg/l              | milligrams per liter  |
| MH                | manhole   |
| mm                | millimeter  |
| MoIM              | Ministry of Interior & Municipalities   |

| <b>Abbreviation</b> | <b>Definition</b>                                  |
|---------------------|--|
| MoE                 | Ministry of Environment                            |
| MoEW                | Ministry of Energy & Water                         |
| No.                 | number   |
| OJT                 | On Job Training                                    |
| OM&T                | operations, maintenance and training               |
| O&M                 | operations and maintenance                         |
| PIU                 | Project Implementation Unit                        |
| PLC                 | programmable logic controller                      |
| ppm                 | part per million                                   |
| PS                  | pump station                                       |
| PVC                 | polyvinyl chloride                                 |
| RCP                 | reinforced concrete pipe                           |
| RFI                 | request for information                            |
| RP                  | results package                                    |
| SOP                 | standard operating procedure(s)                    |
| Sta                 | Station  |
| TAJJ                | TAJJ Establishment for Contracting & Trading       |
| TDH                 | total dynamic head                                 |
| TDS                 | total dissolved solids                             |
| TOC                 | Taking-over Certificate                            |
| TSS                 | total suspended solids                             |
| US                  | United States                                      |
| USAID               | United States Agency for International Development |
| VECP                | value engineering change proposal                  |
| VO                  | variation order                                    |
| VOR                 | variation order request                            |
| WM                  | water main   |
| WTP                 | water treatment plant                              |
| WW                  | wastewater   |
| WWTP                | wastewater treatment plant                         |

## Section 1 Project Background

### Detailed Description of the Project

To protect water resources that are critical to irrigation for agriculture and economic growth for stability in the region, the U.S. Agency for International Development Mission to Lebanon (USAID/Lebanon) commissioned CDM Smith to study, design and build wastewater treatment facilities in the Bekaa Valley to mitigate pollution of the Upper Litani River Basin – one of the most important freshwater resources in Lebanon.

### Study and Design

Based in Beirut, a design team from CDM Smith, working side-by-side with engineers from Lebanese sub-contractor Dar Al-Handasah Consultants (Shair & Partners), completed architectural, structural, process, mechanical, geotechnical and electrical engineering for the design of seven wastewater treatment plants to serve 17 villages. This 13-month, assignment included sampling, subsurface/geotechnical investigations, environmental impact assessments, and preparation of specifications and drawings for tendering. This work was completed successfully as a single task order under the Architect-Engineering Services in the Water Resources, Environmental/ Sanitary, Civil and Industrial Engineering Fields Indefinite Quantity Contract (IQC) [LAG-I-00-98-00034-00].

### Construction

CDM Smith deployed expert construction managers and engineers with experience in the Middle East and the ability to perform under aggressive scheduling, backed by a highly capable home office that has provided continuous support for bilateral- and multilateral-funded projects in the Middle East since the 1970s. The CDM Smith construction team that was based in Beirut, with smaller offices at each project site, provided engineering to enhance constructability; procured equipment and materials locally and internationally; ultimately constructed three WWTPs in Aitanit, Fourzol, and Ablah; and, trained municipal operators to operate and maintain the plants as an institutional capacity building measure toward sustainability.

#### *Successful transfer of skills to local counterparts*

CDM Smith has utilized local contractors as extensively as possible to leverage project funds by engaging in-country resources and build capacity of the local construction industry. The overall cost of the approach has been balanced against the associated risks of quality and schedule impact for each project site.



CDM Smith's approach engaged local contractors, municipal officials and other stakeholders as appropriate in project delivery, to build a broad base of knowledge of the facilities and to work side-by-side with counterparts who will be responsible for management and operations in the near and long terms.

With approval by USAID/Lebanon, CDM Smith invites key local counterparts to join in selected planning meetings, to be informed of progress, to participate in site inspections, to attend briefings by manufacturers and to review documentation to promote full understanding.

As a result of this comprehensive approach to stakeholder engagement, CDM Smith has managed to establish excellent relationships with Lebanese authorities at all levels, including ministries, municipalities, the Bekaa Water Establishment (BWE), and the Litani River Authority (LRA). In addition, CDM Smith had opened channels with other international donors in Lebanon with a shared mutual interest in the wastewater sector, specifically regarding sustainability of treatment facilities.

### ***Treatment Process***

Each plant has the same sequence of processes to treat raw wastewater and stabilize the resulting sludge. Liquid treatment is provided by the following sequence of processes:

- Flow diversion structure
- Influent pump station
- Static fine screens
- Primary clarifiers
- Trickling filter pump station
- Plastic media trickling filters
- Secondary clarifiers
- Chlorine contact tanks



Sludge removed from primary and secondary clarifiers is pumped to anaerobic digesters for stabilization. Digested sludge is removed from the digesters and sent to sludge beds for drying or liquid hauled to landfills for disposal.

This treatment process was selected to meet the wastewater treatment objectives while having the lowest operations cost (in electrical usage) than alternatives evaluated. The process has the additional benefit of being simple to understand and operator compared to other wastewater treatment processes.

### ***Operations and Maintenance***

Responsibility for operations and maintenance of the facilities transfers to the municipalities upon completion, until such time as the BWE – a division of the Lebanese Ministry of Energy and Water – has the institutional capacity to assume this responsibility.

CDM Smith designed the operations and maintenance training (OMT) program to provide the knowledge, and develop the skills, necessary for the efficient and safe operation and maintenance of the new treatment facilities. Each individual assigned to operation, maintenance and management of the new treatment plants receives training specific to assigned tasks and specific facilities. Training program features include:



- On-the-Job Training (OJT) during the commissioning period, through demonstrations and hands-on activities, augmented by classroom lectures as necessary;
- Direct assistance training, conducted with staff trainees as they perform normal work duties and assigned tasks; and,
- Vendor training, which combines classroom training and OJT activities conducted by vendor representatives during

the pre-commissioning and commissioning periods as a part of equipment installation and startup.

At the end of the training program, all training materials such as handouts, etc., are turned over to USAID/Lebanon, and to the beneficiary villages/municipalities/unions.

### *Unique challenges & solutions*

Upon project design startup in October 2004, villages to be serviced by the new treatment plants had not been identified nor was there any information on wastewater flow or characteristics necessary to start the design work. For the first six months, the project teams surveyed the Bekaa Valley to identify municipal wastewater discharges to the Litani River and sampled the raw wastewater to determine the characteristics necessary for design. Additionally, the CDM Smith team worked with the village mayors and the Government of Lebanon to identify suitable locations for the new WWTPs, and to persuade the village municipalities to identify land that they would provide for the construction of the WWTPs. By the end of the design phase in November 2005, seven new energy efficient WWTPs had been designed for specific locations of land provided by the villages. During this critical design development phase, the former Prime Minister, Rafic Hariri, was assassinated on February 14<sup>th</sup>, 2005, starting a period of political turmoil that led to Lebanon's Cedar Revolution. The CDM Smith team was able to continue to focus on the project goals throughout this turbulent period in Lebanon.

During the 34-day military conflict between Israel and Hezbollah that began on July 13, 2006, CDM Smith's two long-term expatriate staff evacuated from Lebanon until the U.S. State Department issued clearances on September 22, 2006. Both were able to keep the project moving forward from their remote postings through regular communication with local staff and by managing logistics and follow-up activities essential to project success. CDM Smith was able to work closely with subcontractors achieve substantial completion of the first plants by implementing several revised project management activities, including direct participation and assistance in locating and negotiating with local specialty subcontractors, increased micromanagement and control of subcontractors site daily work activities, redirection of subcontractors staff to critical path work areas, and development of a schedule recovery plan with subcontractors to accommodate and compensate for time lost during the war.

## Section 2 Scope of Work (Original plus Modifications)

On September 28, 2005, USAID/Lebanon awarded CDM Smith a two-year, stand-alone contract for construction and commissioning of two WWTPs, in Aitanit and Fourzol, including a three-month period of operations and maintenance (O&M) advice and assistance. The 5,000 m<sup>3</sup>/day Aitanit WWTP, near Qaraoun Lake/Dam, where the upper Litani River ends, serves the four villages of Qaraoun, Mashghara, Aitanit and Baaloul, which have a combined estimated population of 28,000 to 32,000. And the 1,000 m<sup>3</sup>/day Fourzol WWTP serves the village of Fourzol, which has an estimated population of 5,000 to 7,000.

On September 12, 2007, USAID modified the construction contract to obligate an additional fund for the project and extend the completion date to December 30, 2008.

On September 26, 2008, USAID/Lebanon modified the construction contract to build two more WWTPs, in Ablah and Chmistar, with a nine-month period of operations and maintenance advice and assistance, and extend O&M support at Aitanit and Fourzol from three months to a full year. The modification obligated an additional fund, and set a completion date of June 29, 2011.

On April 28, 2010, USAID removed the construction of the 4<sup>th</sup> plant from contract scope and added a task to do an assessment for the sewer collection system in five villages around Aitanit WWTP, namely: Qaraoun, Mashghara, Aitanit, Baaloul, and Lala. During this period of time, the 2,000 m<sup>3</sup>/day Ablah WWTP which serves the three villages of Ablah, Niha, and Nabi-Ayla which has a combined estimated population of 10,000 to 13,000 was under construction.

On June 29, 2011, USAID extended the completion date until July 31, 2012 and modified the statement of work to add additional sludge drying beds at Ablah facility, and to prolong the Fourzol's advise and assist stage until the end of the performance period (July 31, 2012).

On December 22, 2011, USAID signed contract amendment no.9 to add additional upgrade and enhancements to the three built wastewater treatment facilities. The major task of this additional scope is the construction of approximately 2,000 square meters of sludge drying beds at Fourzol WWTP in order to receive excess wet sludge from Ablah facility.

Table 2-1 below is a summary table of USAID's original contract, and all the modifications that were associated with the phase II of the SVWWTs project.



Table 2-1 USAID's Contract and Modifications (scope, budget, and time)

| Mod. #   | Description of Amendment/Modification  | Timeframe (Schedule)  | Date Signed |
|----------|--|---|-------------|
| Original | <ul style="list-style-type: none"> <li>- Construction of two WWTPs from the seven designed WWTPs in the Bekaa Valley of Lebanon.</li> <li>- Advise &amp; Assist for 3 months after construction and commissioning periods.</li> </ul>  | <p>2 Years<br/>(Sep. 30, 2005 till<br/>Sep. 29, 2007)<br/><br/>+ 6 months<br/>(Optional Period)</p> | 29-Sep-2005 |
| 1        | <ul style="list-style-type: none"> <li>- Provide incremental funding.</li> </ul>   | <p>2 Years<br/>(Sep. 30, 2005 till<br/>Sep. 29, 2007)</p>   | 18-Jan-2006 |
| 2        | <ul style="list-style-type: none"> <li>- Exercise the option period.</li> <li>- Increase the Total Expected Cost.</li> <li>- Extend the completion date of the contract to December 30, 2008.</li> <li>- Modify the scope of work to include the construction of Aitanit and Fourzol WWTPs, and perform the construction of sludge drying beds for Aitanit WWTP.</li> </ul>  | <p>Performance<br/>Period until<br/>December 30, 2008</p>   | 11-Sep-2007 |
| 3        | <ul style="list-style-type: none"> <li>- Increase the obligated amount.</li> <li>- Increase the total estimated cost.</li> <li>- Extend the duration by 30 months for a revised completion date of June 29, 2011.</li> <li>- Revise the Statement of Work to add two WWTPs and extend the duration of the Assist and Monitoring phase as such: 12 months for Aitanit &amp; Fourzol WWTPs, and 9 months for Ablah and the other selected WWTP.</li> </ul> | <p>Performance<br/>Period until<br/>June 29, 2011</p>   | 26-Sep-2008 |

|   |  |  |             |
|---|--|--|-------------|
| 4 | - Add FAR clause "52.225-13 Restrictions on Certain Foreign Purchases".  |  | 19-Feb-2009 |
| 5 | - Increase the obligated amount.<br>- Revise the Statement of Work to identify Chmistar as the fourth WWTP and add land purchase at no additional cost to USAID.   | Performance Period until June 29, 2011 | 16-Aug-2009 |
| 6 | - Remove Chmistar as the fourth WWTP.<br>- Add the component to do networks assessments for the four beneficiary villages of Aitanit WWTP.<br>- Add the Advise & Assist reporting requirement.<br>- Add the Performance Monitoring Plan requirement.<br>- Add the Branding and Marking plan.<br>- Add the Participant Training clause.   | Performance Period until June 29, 2011 | 16-Dec-2009 |
| 7 | - Delegate approval of International Travel to the Contracting Officer Technical Representative (COTR).  |  | 14-Jun-2010 |
| 8 | - Modify the Statement of Work to add sludge drying beds at Ablah WWTP.<br>- Extend the Advise & Assist period for Fourzol WWTP till the end of the project.<br>- Extend the completion date from June 29, 2011 to July 31, 2012 at no additional cost to USAID.   | Performance Period until July 31, 2012 | 29-Jun-2011 |
| 9 | - Modify the Statement of Work to add additional activities within the scope of work at no additional cost to USAID, mainly: (1) enhancement works for the three WWTPs, and (2) design and construction of additional 2,000m2 of sludge drying beds in the Fourzol WWTP.<br>- Add FAR clause "52.222-50 Combating Trafficking in Persons."<br>- Add language on Vetting requirements | Performance Period until July 31, 2012 | 22-Dec-2011 |

## Section 3 Accomplishments and Project(s) Milestones

The main Memorandum of Understanding (MOU) for the Small Villages Wastewater Treatment Systems phase II project was signed between the Ministry of Interior and Municipalities (MoIM) and the USAID Lebanon mission on December 21<sup>st</sup>, 2005.

### 3.1 Aitanit WWTP

#### *Aitanit WWTP- PreConstruction Schedule*

| Pre-Construction Stage |  |            |             |
|------------------------|--|------------|-------------|
| Project Activity       | Project Deliverable  | Start Date | Finish Date |
| Pre-Construction       | LRA approval to grant the land for the construction of Aitanit WWTP/ MOU/ Building Permit/ USAID NTP | 29-Sep-05  | 2-Nov-06    |
| Pre-Construction       | Signing of MOU between USAID and beneficiary villages: Mashghara, Qaraoun, Aitanit, and Baaloul      |            | 20-Jun-06   |
| Pre-Construction       | Issuance of Building Permit  |            | 2-Nov-06    |
| Pre-Construction       | USAID's Notice-To-Proceed  |            | 2-Nov-06    |

#### *Aitanit WWTP- Construction Schedule*

| Construction Stage |                                  |            |             |
|--------------------|----------------------------------|------------|-------------|
| Project Activity   | Project Deliverable              | Start Date | Finish Date |
| Construction       | All Works Construction           | 3-Nov-06   | 10-Nov-08   |
| Construction       | Sludge Beds Construction         | 5-June-08  | 10 Apr-09   |
| Construction       | EDL Power Connection             | 23-Oct-08  | 29-Feb-09   |
| Construction       | Substantial Completion Snag List | 1-Nov-08   | 8-Mar-09    |

#### *Aitanit WWTP- Commissioning Schedule*

The commissioning stage starts after completion of the construction stage during which CDM Smith was fully responsible for the operations and maintenance of the facilities. This stage includes "Start-up Testing" and "Tests on Completion", as follows:

| Commissioning Stage |  |            |             |
|---------------------|--|------------|-------------|
| Project Activity    | Project Deliverable                          | Start Date | Finish Date |
| Functional Testing  | Functional Testing Plan (Submittal to USAID) | 25-Aug-08  | 25-Aug-08   |

|  |   |   |            |
|--|---|---|------------|
| Functional Testing                                       | Facility Functional Testing<br>(tank leak tests, pipe pressure tests,<br>manhole tests, etc)  | 20-Aug-08   | 3-Mar-09   |
| Commissioning -<br>General                               | 90-day Commissioning period<br>(Period when CDM is fully<br>responsible for O&M at the WWTP)  | 4-Mar-09  | 3-Jun-09   |
| Start-up Testing   | Clean Water Test  | 4-Mar-09  | 4-Apr-09   |
| Start-up Testing   | Clean Water Test Punch List   | 5-Apr-09  | 25 Apr- 09 |
| Diversion of Sewage to the plant for permanent operation |   | 23-Apr-09   |            |
| Tests on Completion                                      | Test on Completion<br>(30 consecutive days run test to check<br>if WWTP meets the design and<br>operational requirements. All<br>Mech/Elect equipment shall remain<br>free of breakdowns during test<br>period) | 23-Apr-09<br>(Date sewage<br>1 <sup>st</sup> entered<br>WWTP) | 30-May-09  |
| Effluent Quality Certification                           |   | 23-Aug-11   | 14-Sep-11  |

### *Aitanit WWTP- Defects & Liability Period*

The defects and liability period contractually started on the first day of the tests on completion and ended three months from the start date of the advise and assist. For the Aitanit WWTP, the start date of the tests on completion is April 23<sup>rd</sup>, 2009 which was the day the raw sewage was brought into the facility for treatment.

No defects were discovered during the defects and liability period (April 23<sup>rd</sup>, 2009 thru August 22<sup>nd</sup>, 2009).

### *Aitanit WWTP- Advise & Assist Stage*

The 12-month advise and assist period for the Aitanit facility started on June 4<sup>th</sup>, 2009. Following the completion of the one-year contract required advise & assist period, CDM Smith provided an additional 12 months of part time advise and assist follow-up service for Aitanit WWTP.

During the advise and assist (A&A) stage, CDM Smith tasks included the following:

- assessed the knowledge, experience and capabilities of the staff (municipal Operators) at each facility,
- provided ongoing training for the municipal operators,
- supervised staff activities,
- assisted staff with the performance of the required activities,
- was fully responsible for the overall Operation & Maintenance (O&M) and performance of the facilities,
- conducted effluent quality monitoring
- trained facility staff on sampling and effluent monitoring and process

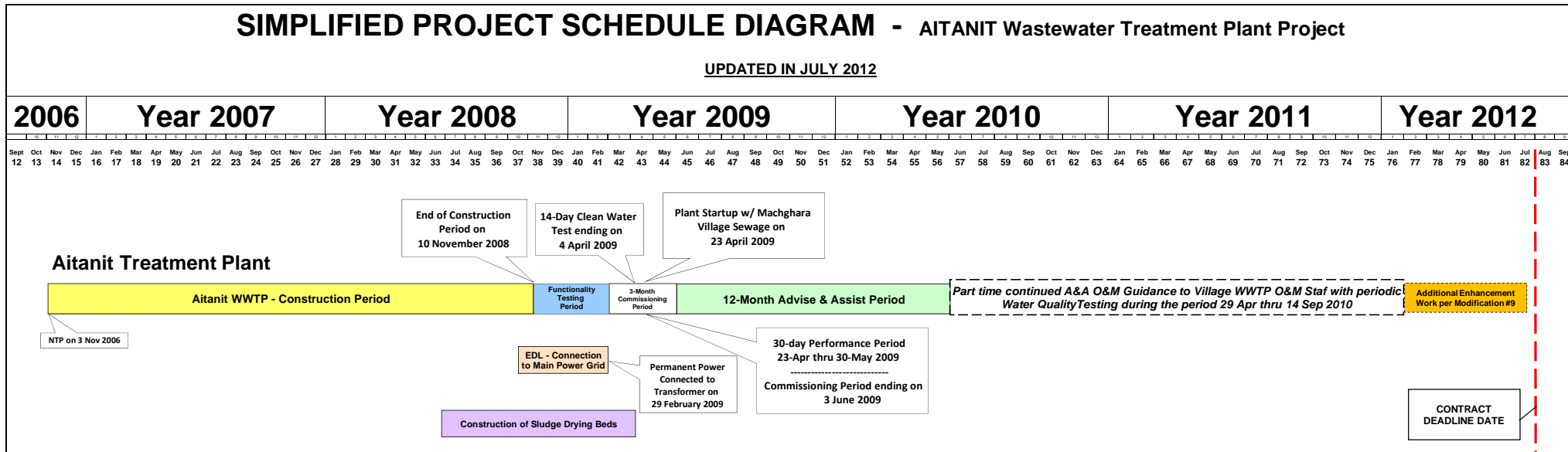
- control laboratory testing at an appropriate level to each site,
- Troubleshooting was also provided for any operating problems that emerge during this period and all problems resolved.

A site specific operation/maintenance training (OMT) plan was also prepared for the Aitanit WWTP system. CDM Smith submitted the OMT plan for Aitanit WWTP on July 14<sup>th</sup>, 2008.

**Additional Milestones for Aitanit WWTP project:**

- On April 29<sup>th</sup>, 2008 CDM Smith received the Notice-To-Proceed (NTP) from USAID for the new 7,200 square meters of sludge drying beds.
- The inauguration of the Aitanit WWTP took place on May 5<sup>th</sup>, 2009.
- The one-year advise and assist stage started on June 4<sup>th</sup>, 2009.
- The 4-month defects and liability period started on April 23<sup>rd</sup>, 2009 and ended on August 22<sup>nd</sup>, 2009).
- The Site Final Inspection was done on September 23<sup>rd</sup>, 2010.
- The Site Completion Report was delivered to USAID Lebanon on October 29<sup>th</sup>, 2010.
- The Amended Site Completion Report and Final Inspection Certificate were delivered to USAID Lebanon on June 27<sup>th</sup>, 2012.
- The Aitanit WWTP Project Manual was delivered to USAID Lebanon on July 30<sup>th</sup>, 2012.

Aitanit WWTP – Schematic Schedule Diagram



### 3.2 Fourzol WWTP

#### Fourzol WWTP- PreConstruction Schedule

| Pre-Construction Stage |  |            |             |
|------------------------|--|------------|-------------|
| Project Activity       | Project Deliverable  | Start Date | Finish Date |
| Pre-Construction       | Fourzol approval to grant the land for the construction of Fourzol WWTP/ MOU/ Building Permit/ USAID NTP | 29-Sep-05  | 5-Jul-07    |
| Pre-Construction       | Signing of MOU between USAID and beneficiary village (Fourzol)   |            | 29-Mar-07   |
| Pre-Construction       | Issuance of Building Permit  |            | 29-Jun-07   |
| Pre-Construction       | USAID's Notice-To-Proceed  |            | 5-Jul-07    |
| Pre-Construction       | Debris Removal   | 1-Aug-07   | 14-Aug-07   |

#### Fourzol WWTP- Construction Schedule

| Construction Stage |   |            |             |
|--------------------|---|------------|-------------|
| Project Activity   | Project Deliverable   | Start Date | Finish Date |
| Construction       | All Works Construction  | 17-Aug-07  | 13-May-09   |
| Construction       | Neighbor's Permission to Cross their Land for Influent & Effluent Pipelines | 5-Feb-09   | 15-Mar-09   |
| Construction       | Substantial Completion Snag List  | 5-Dec-08   | 20-Jul-09   |

#### Fourzol WWTP- Commissioning Schedule

The commissioning stage starts after completion of the construction stage during which CDM Smith was fully responsible for the operations and maintenance of the facilities. This stage includes "Start-up Testing" and "Tests on Completion", as follows:

| Commissioning Stage |  |            |             |
|---------------------|--|------------|-------------|
| Project Activity    | Project Deliverable  | Start Date | Finish Date |
| Functional Testing  | Functional Testing Plan (Submittal to USAID)   | 1-Feb-09   | 1-Feb-09    |
| Functional Testing  | Facility Functional Testing (tank leak tests, pipe pressure tests, manhole tests, etc) | 1-Apr-09   | 2-Jun-09    |

|  |  |           |           |
|--|--|-----------|-----------|
| Commissioning - General                                  | 90-day Commissioning period<br>(Period when CDM is fully responsible for O&M at the WWTP)  | 2-Jun-09  | 1-Sep-09  |
| Start-up Testing   | 14-day Clean Water Test  | 3-Jun-09  | 17-Jun-09 |
| Start-up Testing   | Clean Water Test Punch List  | 20-Jun-09 | 31-Jul-09 |
| Diversion of Sewage to the plant for permanent operation |  | 01-Aug-09 |           |
| Tests on Completion                                      | Test on Completion<br>(30 consecutive days run test to check if WWTP meets the design and operational requirements. All Mech/Elect equipment shall remain free of breakdowns during test period) | 1-Aug-09  | 30-Aug-09 |
| Effluent Quality Certification                           |  | 30-Jun-10 | 1-Sep-10  |

#### ***Fourzol WWTP- Defects & Liability Period***

The defects and liability period contractually started on the first day of the tests on completion and ended three months from the start date of the advise and assist. For the Fourzol WWTP, the start date of the tests on completion was August 1<sup>st</sup>, 2009 which is the day the raw sewage was brought into the facility for treatment.

No defects were discovered during the defects and liability period (August 1<sup>st</sup>, 2009 thru December 1<sup>st</sup>, 2009).

#### ***Fourzol WWTP- Advise & Assist Stage***

The original advise and assist (A&A) period for the Fourzol facility was one year starting on September 4<sup>th</sup>, 2009; however, this A&A got extended until the end of contract performance period per contract modification no. 8 (22 December 2011) whereby CDM Smith provided 23 additional months of A&A for Fourzol WWTP.

During the advise and assist (A&A) stage, CDM Smith tasks included the following:

- assessed the knowledge, experience and capabilities of the staff (municipal Operators) at each facility,
- provided ongoing training for the municipal operators,
- supervised staff activities,
- assisted staff with the performance of the required activities,
- was fully responsible for the overall Operation & Maintenance (O&M) and performance of the facilities,
- conducted effluent quality monitoring
- trained facility staff on sampling and effluent monitoring and process control laboratory testing at an appropriate level to each site,
- Troubleshooting was also provided for any operating problems that emerge during this period and all problems resolved.

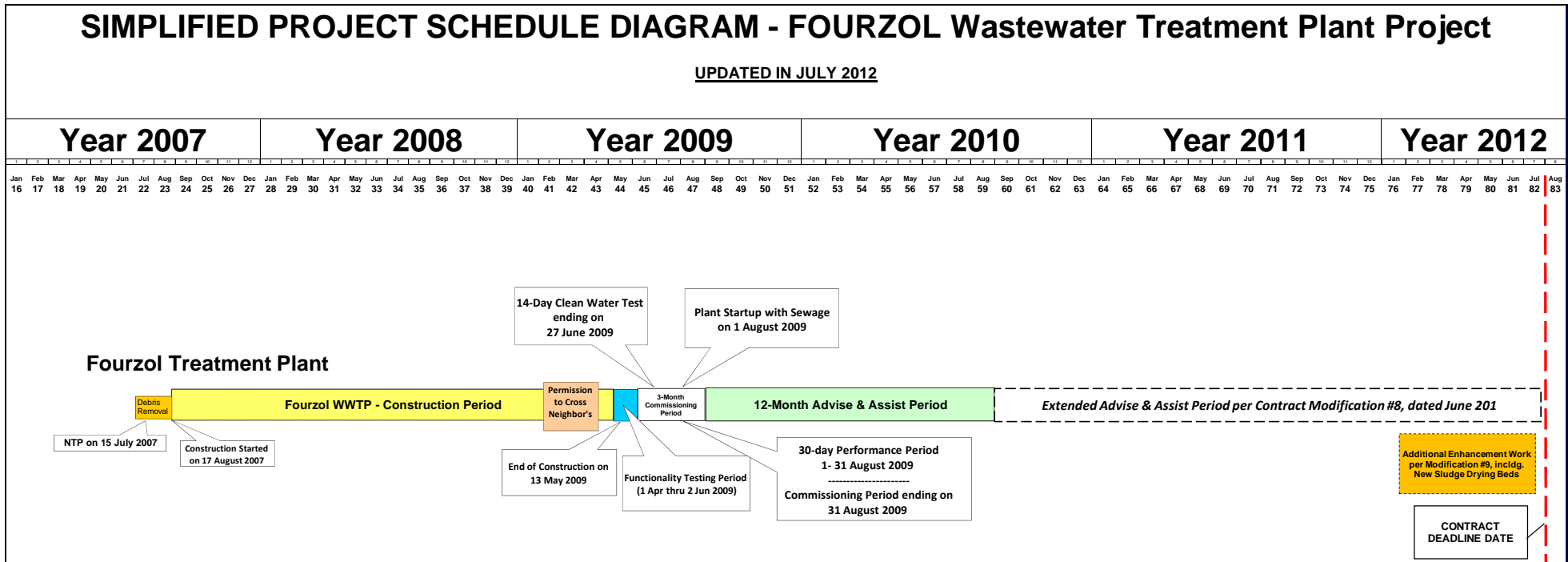


A site specific operation/maintenance training (OMT) plan was also prepared for the Fourzol WWTP system. CDM Smith submitted the OMT plan for Fourzol WWTP on February 1<sup>st</sup>, 2009.

**Additional Milestones for Fourzol WWTP project:**

- The Inauguration of the Fourzol WWTP took place on November 21<sup>st</sup>, 2009.
- The one-year advise and assist stage started on September 4<sup>th</sup>, 2009.
- The 4-month defects and liability period started on August 1<sup>st</sup>, 2009 and ended on November 30<sup>th</sup>, 2009.
- The Site Final Inspection was done on September 23<sup>rd</sup>, 2010.
- The Site Completion Report was delivered to USAID Lebanon on October 29<sup>th</sup>, 2010.
- On December 22<sup>nd</sup>, 2011 USAID modified the contract (amendment #9) to include additional enhancements and construction of additional sludge drying beds (approx. 2000 m<sup>2</sup>) to accept some generated wet sludge quantities from the Ablah WWTP.
- The Amended Site Completion Report and the Final Inspection Certificate were delivered to USAID Lebanon on July 3<sup>rd</sup>, 2012.
- The Fourzol WWTP Project Manual was delivered to USAID Lebanon on July 30<sup>th</sup>, 2012.

Fourzol WWTP – Schematic Schedule Diagram



### 3.3 Ablah WWTP

#### *Ablah WWTP- PreConstruction Schedule*

| PreConstruction Stage |   |            |             |
|-----------------------|---|------------|-------------|
| Project Activity      | Project Deliverable   | Start Date | Finish Date |
| Pre-Construction      | MOU/ Building Permit/ USAID NTP   | 26-Sep-08  | 11-Sep-09   |
| Pre-Construction      | Signing of MOU between USAID and beneficiary villages: Ablah, Niha, and Nabi-Ayla     |            | 27-Apr-09   |
| Pre-Construction      | Issuance of Building Permit   |            | 30-Jun-09   |
| Pre-Construction      | Award and Termination of General Subcontractor (Braidy Est. for Engrg. & Contracting) | 25-Aug-09  | 15-Oct-09   |
| Pre-Construction      | Award and Termination of General Subcontractor (Abou Dib for Engrg. & Contracting)    | 28-Oct-09  | 18-Dec-09   |
| Pre-Construction      | Mobilization and Dewatering Control System  | 4-Jan-10   | 1-Feb-10    |

#### *Ablah WWTP- Construction Schedule*

| Construction Stage |  |            |             |
|--------------------|--|------------|-------------|
| Project Activity   | Project Deliverable  | Start Date | Finish Date |
| Construction       | All Works Construction (including new sludge drying beds as approved by USAID) | 1-Feb-10   | 31-Aug-11   |
| Construction       | Substantial Completion Snag List   | 15-Sep-11  | 31-Oct-11   |

#### *Ablah WWTP- Commissioning Schedule*

The commissioning stage (during which CDM Smith is fully responsible for the operations and maintenance of the facilities) should have started just after completion of the construction stage to be followed by the permanent operation of the plant. This stage includes "Start-up Testing" and "Tests on Completion", per the Contract description. Due to the unavailability of local operating staff being provided by the Ablah municipality, CDM Smith was delayed in performing plant startup which resulted in shortened process commissioning and Advise & Assist periods. CDM Smith however, prior to the permanent operation of the plant that started on July 12, 2012, still performed separately the two major activities required by

contract under this phase: “startup testing” and “tests on completion”. The commission stage is thus summarized as follows:

| Commissioning Stage                                      |   |                                 |                                 |
|--|---|---------------------------------|---------------------------------|
| Project Activity   | Project Deliverable   | Start Date                      | Finish Date                     |
| Functional Testing                                       | Functional Testing Plan<br>(Submittal to USAID)   | 31-Aug-11                       | 31-Aug-11                       |
| Functional Testing                                       | Facility Functional Testing<br>(tank leak tests, pipe pressure tests,<br>manhole tests, etc.)   | 1-Aug-11                        | 31-Oct-11                       |
| Commissioning - General                                  | 90-day Commissioning period<br>(Period when CDM Smith is fully<br>responsible for O&M at the WWTP)  | Refer to above<br>clarification | Refer to above<br>clarification |
| Start-up Testing   | 7-day Clean Water Test  | 07-Nov-11                       | 13 Nov--11                      |
| Start-up Testing   | Clean Water Test Punch List   | 14-Nov-11                       | 14-Nov-11                       |
| Tests on Completion                                      | Test on Completion<br>(30 consecutive days run test to check if<br>WWTP meets the design and<br>operational requirements. All<br>Mech/Elect equipment shall<br>remain free of breakdowns<br>during test period) | 20-Apr-12                       | 22-Jun-12                       |
| Diversion of Sewage to the plant for permanent operation |   | 12-Jul-12                       |                                 |
| Effluent Quality Certification                           |   | 09-May-12                       | 20-Jun-12                       |

### *Ablah WWTP- Defects & Liability Period*

Per the contract, the defects and liability period is four months and shall start on the first day of the tests on completion and end three months from the start date of the advise and assist stage. For the Ablah WWTP, this chronologic sequence could not be met due to the unavailability of municipal operators.

CDM Smith however, certifies that no defects were discovered during the periods when the facility was operated under the supervision of CDM Smith, specifically the ‘clean water pre-startup testing period’ from November 7<sup>th</sup>, 2011 thru November 14<sup>th</sup>, 2012, and during the ‘tests on completion period while running the plant with full incoming sewage flows’ from April 20<sup>th</sup>, 2012 thru June 22<sup>nd</sup>, 2012.

***Ablah WWTP- Advise & Assist Stage***

Per the contract, the advise and assist period is a nine month period starting after the successful completion of the Commissioning stage. For the Ablah WWTP, this requirement was not sequenced in the intended order and was modified due to the unavailability of village supplied municipal operators.

Nevertheless, CDM Smith considers that it has fulfilled the intent of the Ablah Advise & Assist program of work and specifically the on-the-job technical training requirement through having hired and trained Mr. Mohamed Boudaya as a plant operator trainee for a 12-month period during which he received daily instruction and guidance regarding the running of the new WWTP and assisted CDM Smith with the commissioning and operational testing of the Ablah plant from the period May 2011 till June 2012. Following his work experience with CDM Smith, Mr. Boudaya was hired by the Municipalities of Ablah and Fourzol to operate both facilities as of July 1<sup>st</sup>, 2012. Full details of the Ablah WWTP operator training subjects, lesson plans, and student hours spent in classroom and field, and learned skills are documented and discussed at the end of this report in Appendix E - Final Training Report.

**Additional Milestones for Ablah WWTP project:**

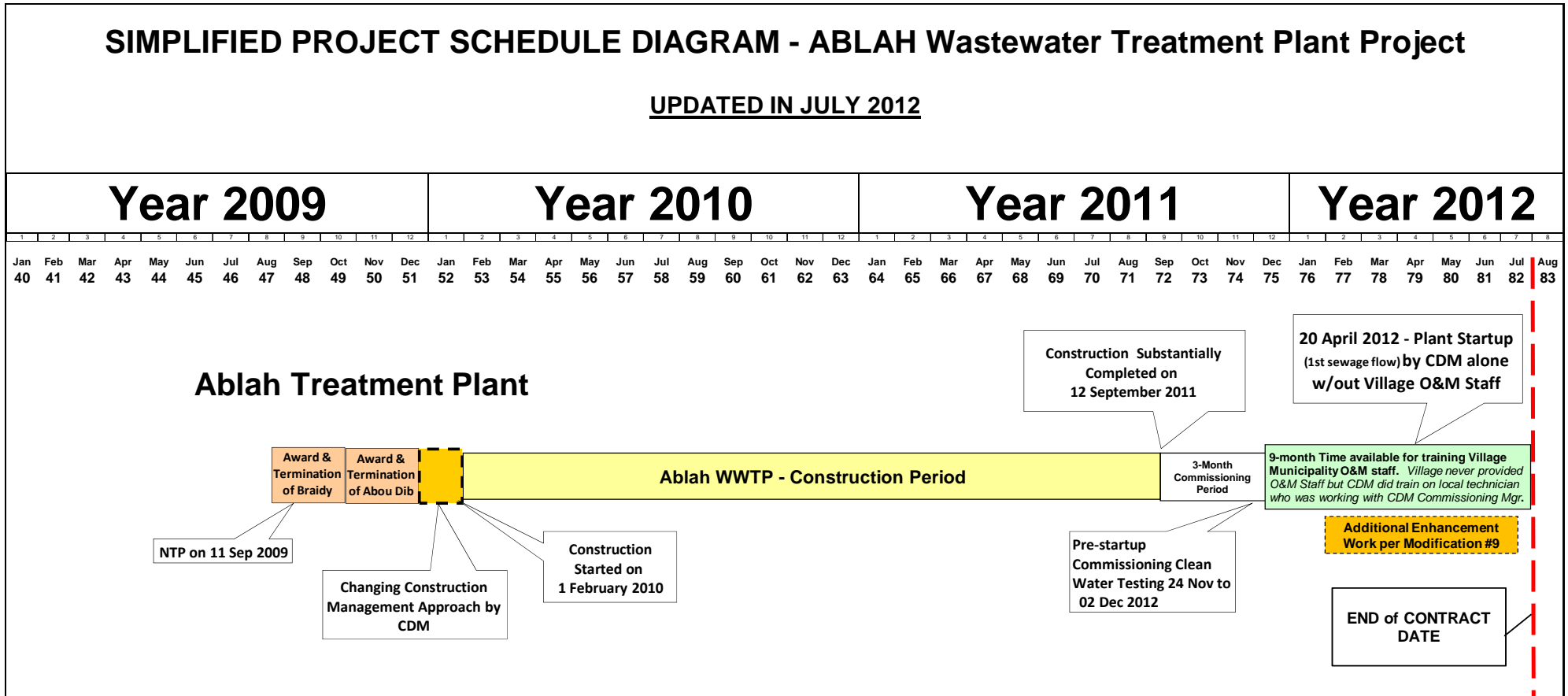
- Groundbreaking event of Ablah WWTP was celebrated on August 11<sup>th</sup>, 2009 under the patronage of her Excellency the US Ex-Ambassador for Lebanon Ms. Michel Sison.
- USAID granted CDM Smith its consent to subcontract the construction works to Nazih Braidy Est. for Engineering & Contracting on August 25<sup>th</sup>, 2009. The subcontract agreement with Braidy Est. was signed on August 31<sup>st</sup>, 2009.
- On September 17<sup>th</sup>, 2009, the ex-landowner finally removed the grape vineyards off the site.
- On September 25<sup>th</sup>, 2009, Braidy Est. requested withdrawal from project execution unless additional cost compensation of \$331,303 and time extension is granted. This request could not be justified and therefore not approved. Contract with Braidy Est. got terminated on October 14<sup>th</sup>, 2009.
- On October 28<sup>th</sup>, 2009, Abou Dib for Engrg. Company was approved to execute the construction works of the Ablah WWTP. However, Abou Dib was unable to execute their bid plan on the ground which soon became obvious during the first stages of site mobilization. In the end, Abou Dib opted to withdraw from the project, and so their subcontract agreement was subsequently terminated on December 18<sup>th</sup>, 2009.
- After experiencing serious problems with the two previously general subcontractors for the Ablah WWTP construction project, and given our more than three years of work experience executing the Aitanit and Fourzol Village WWTPs using general subcontractors, CDM Smith concluded that construction works for the Ablah WWTP are too small to attract a competent single-package subcontractor.

Therefore, CDM Smith decided to split the works into several packages, such as: (1) Earthworks (excavation & soil replacement), (2) Concrete Works, (3) Electrical Works, (5) Mechanical Works, (6) Miscellaneous Metals, (7) Concrete Finishing & Waterproofing, (8) Yard Piping, etc.. per CDM Smith's letter to USAID Contracting

Officer on December 17<sup>th</sup>, 2009. Consequently, all the construction works got completed on time and well within budget.

- In November 2011, the Ablah Mayor received the approval from Ablah's Municipality Council to private subcontract the O&M works to a local specialized contractor (SEC), however, per the MoIM response to Ablah, the Municipality needs to solicit three quotes. CDM Smith asked the Mayor to hire at least one plant operator (Mr. Mohamad Boudaya) and one security guard. Unfortunately no action was taken to allow not only the treatment of raw sewage but also to initialize the advise & assist stage which ends in July 31<sup>st</sup>, 2012. So, in an effort to complete CDM Smith contractual obligations, CDM Smith was authorized to startup and operate the treatment facility without village providing staff, in order to go through the Tests on Completion per the contract requirements and to demonstrate that the WWTP works. To that extent, CDM Smith operated the facility for 2 months starting April 20<sup>th</sup> through June 24<sup>th</sup>, 2012. Meantime, CDM Smith continued to provide on-the-job training to Mr. Mohamad Boudaya in case he gets hired by the villages to run the wastewater treatment plants at Fourzol and Ablah.
- On July 11<sup>th</sup>, 2012, USAID Head of the Economic Growth Dpt. and USAID COTR met onsite with Colonel Haber from the MoIM and the Mayor of Ablah. The MoIM and the Mayor assured USAID that the facility will run 24/7 as of July 1<sup>st</sup>, 2012 by hiring Mr. Mohamad Boudaya who has been trained by CDM Smith.
- On July 26<sup>th</sup>, 2012 CDM Smith field team visited the site to acknowledge that the Ablah WWTP and the Fourzol WWTP are in full operation mode.
- Post project completion follow-up: three months after the project completion date (i.e. October 2012), Mr. Mohamad Boudaya the WWT plant Operator working for both the Fourzol and Ablah Village Municipalities communicated to CDM Smith that both of these treatment plants remain in full operation and running without interruptions or raw sewage flow bypassing. In addition it was reported that the village municipalities are sustaining the operation of these facilities through the payment of recurrent operating costs for standby power fuel, EDL electricity, and staff salaries.

*Ablah WWTP – Schematic Schedule Diagram*



## Section 4 Construction Costs

### 4.1 Aitanit WWTP Project

#### 4.1.1 Subcontracting Works:

For the Aitanit WWTP, CDM Smith used the traditional construction management (CM) approach, whereby multi-disciplined general contractors provided all the construction subcontractors, labor, and equipment necessary to complete the scope.

Based on the approved tendering approach and bidding procedures, CDM Smith hired the following local subcontractors for the execution of the work.

#### *Aitanit WWTP- Subcontractors & Budgets*

| Name of Subcontractor                         | Type of Work  |
|---|---|
| TAJJ Establishment for Contracting & Trading  | <b>Civil, Structural, and Architectural Works</b> , including: site clearing, excavation, backfilling & compaction, yard piping and manholes, concrete, waterproofing, miscellaneous metals, masonry, painting, doors & windows, tiles, and other civil works |
| EMCO Engineering Ltd.                         | <b>Mechanical and Electrical:</b> process piping, buried cables, installation of equipment, control panels, lighting system, HVAC, Plumbing, and other electromechanical works  |
| SANABEL s.a.r.l.                              | <b>Sludge Drying Beds-- Civil, Structural and Mechanical Works:</b> site clearing, excavation, concrete, waterproofing, decant boxes, slide gates, yard piping, process piping, and other related works   |
| Other local Subcontractors                    | <b>Miscellaneous works:</b> fence, stone wall, stairs for PC tanks, etc...  |
| <i>Total Subcontracts Amount = \$3,306,61</i> |   |

All the Aitanit WWTP Major Subcontractors have been fully paid and have signed Final Payment Certificates and Release of Lien Certificates.



**4.1.2 Equipment & Materials Procurement:**

The major equipment and materials for Aitanit WWTP project were either procured by CDM Smith from the US, or procured by the subcontractors via their contractual scope, or procured/manufactured locally by both CDM Smith and its subcontractors.

*Aitanit WWTP - Equipment/Materials table*

|   |   |
|---|---|
| The equipment purchased through CDM Smith home office in the US, and shipped to Lebanon   | static screens, trickling filter distributors, trickling filter media, trickling filter blowers (fans), slide gates, chemical feed systems and laboratory equipment   |
| The materials/equipment purchased through CDM Smith Subcontractors as part of their scope | concrete, reinforced steel, waterproofing products, upvc pipes, upvc fittings, gratings, and media glue solvents  |
| The equipment purchased from outside Lebanon through CDM Smith Subcontractors             | Pumps, Standby Generator, DI pipes, valves, fittings, and flow meters   |
| The equipment fabricated locally  | Control Panels, GRP troughs, telescopic valves, transformers, stop plates, decant boxes' slide gates, signs, and miscellaneous metals (monorails, gratings supports & brackets, ductwork for fans, windows, doors, stairs and railings) |

The total cost of equipment and materials for the Aitanit WWTP project is \$894,580.

ALL Equipment and Materials manufacturers, vendors, and suppliers have been paid in full.

## 4.2 Fourzol WWTP Project

### 4.2.1 Subcontracting Works & Budgets:

For the Fourzol WWTP, CDM Smith used the traditional construction management (CM) approach, whereby multi-disciplined general contractors provided all the construction subcontractors, labor, and equipment necessary to complete the scope.

Based on the approved tendering approach and bidding procedures, CDM Smith hired the following local subcontractors for the execution of the work.

#### *Fourzol WWTP - Subcontractors & Budgets*

| Name of Subcontractor                          | Type of Work   |
|--|--|
|  | <b>Removal of Debris</b>   |
| TAJJ Establishment for Contracting & Trading   | <b>Civil, Structural, Architectural, Mechanical and Electrical Works</b> , including: site clearing, excavation, backfilling & compaction, yard piping and manholes, concrete, waterproofing, stairs, masonry, painting, doors & windows, tiles, fence, and other civil works process piping, buried cables, installation of equipment, control panels, lighting system, HVAC, Plumbing, and other electromechanical works |
| Other local Subcontractors                     | <b>Miscellaneous works:</b> extra base-course, handrails, gratings, etc...   |
| Miscellaneous Subcontractors                   | <b>Extra Sludge Drying Beds &amp; Enhancement Works</b> , including: earthworks, concrete, waterproofing, yard piping, asphaltting, metal sheds, steel fence barrier, and other miscellaneous works.   |
| <b>Total Subcontracts Amount = \$1,429,271</b> |  |

All the Fourzol WWTP Major Subcontractors were fully paid and have signed Final Payment Certificates and Release of Lien Certificates.

**4.2.2 Equipment & Materials Procurement:**

The major equipment and materials for Fourzol WWTP project were either procured by CDM Smith from the US, or procured by the subcontractors via their contractual scope, or procured/manufactured locally by both CDM Smith and its subcontractors.

*Fourzol WWTP - Equipment/Materials table*

|   |   |
|---|---|
| Equipment purchased through CDM Smith home office in the US, and shipped to Lebanon   | static screens, trickling filter distributors, trickling filter media, trickling filter blowers (fans), slide gates, pumps, chemical feed systems and laboratory equipment  |
| Materials/equipment purchased through CDM Smith Subcontractors as part of their scope | concrete, reinforced steel, waterproofing products, upvc pipes, upvc fittings, gratings, and media glue solvents  |
| Equipment purchased from outside Lebanon through CDM Smith Subcontractors             | Standby generator, DI pipes, valves, fittings, and flow meters  |
| Equipment fabricated locally  | Control panels, GRP troughs, telescopic valves, transformers, stop plates, decant boxes' slide gates, signs, and miscellaneous metals (monorails, gratings supports & brackets, ductwork for fans, windows, doors, stairs and railings, metal sheds, and steel fence barrier) |

The total cost of equipment and materials for the Fourzol WWTP project is \$606,786.

ALL Equipment and Materials manufacturers, vendors, and suppliers have been paid in full.

### 4.3 Ablah WWTP Project

#### 4.3.1 Subcontracting Works & Budgets:

For the Ablah WWTP, CDM Smith used multiple local community contractors to provide construction services each in their own specialty.

Based on the approved tendering approach and bidding procedures for the Ablah WWTP, CDM Smith hired the following local subcontractors for the execution of the work.

#### *Ablah WWTP - Subcontractors & Budgets*

| Type of Work  |
|---|
| General Subcontractor-- started earthworks for one month. Contract was terminated afterwards.   |
| General Subcontractor-- started earthworks for two months. Contract was terminated afterwards.  |
| Earthworks phase I  |
| Earthworks phase II   |
| Project Planning and Scheduling   |
| Site Supervision  |
| Site Engineer & Supervisor  |
| Quality Control Testings  |
| Concrete Works for Trickling Filter Tanks #1 & #2   |
| Concrete Works for Anaerobic Digester & Final Clarifier Tanks   |
| Concrete Works for Primary Clarifier, Trickling Filter Pump Station, Fine Screening Facility, and Influent Pump Station   |
| Concrete Works for Administration & Chemical Bldgs., Wet Weather Diversion Structure, Chlorine Channel, Sludge Drying Beds, Effluent Discharge Box, and Misc. Concrete Pads |
| Underground Waterproofing and Concrete Waterproofing  |
| Interior Waterproofing  |
| Mechanical Works  |

|   |
|---|
| Electrical Works & Control Panels   |
| Miscellaneous Metal Works- Gratings, Railings, & Stairs   |
| Daily Site Labors   |
| Miscellaneous Works: Dewatering, Compaction, unloading of truck deliveries, Painting, Plastering, Plumbing, Cabinets & Countertops, Fence, Steel Fence, Lightning Protection System, etc... |
| <b>Total Subcontract Amount = \$889,556</b>   |

All the Ablah WWTP Major Subcontractors have been fully paid by CDM Smith and have signed Final Payment Certificates and Release of Lien Certificates.

**4.3.2 Equipment & Materials Procurement:**

The major equipment and materials for Ablah WWTP project were either procured by CDM Smith from the US (table 4.3.2-A) or from Lebanon’s market (table 4.3.2-B).

*Table 4.3.2-A Ablah WWTP - Equipment/Materials manufactured in the USA*

| <b>Item Description</b>                                       |
|---|
| Trickling Filter Media System                                 |
| Standby Generator   |
| Shipping of Pumps, Screens, Slide/Weir Gates, & Lab Eqpt.     |
| Shipping of TF Media, TF Distributors, TF Fans, & Plug Valves |
| Waterstop Rings for Wall Pipe Inserts                         |
| Chemical Feed Pumps & Accessories                             |
| Trickling Filter Rotary Distribution Arms                     |
| Laboratory Equipment  |
| Static Screens  |
| Plug Valves   |
| Submersible & Sludge Pumps (Fairbanks Morse)                  |
| Slide Gates   |

|                          |
|--------------------------|
| Farm Tractor             |
| Shipping of Farm Tractor |
| <b>Total = \$594,760</b> |

**Table 4.3.2-B Ablah WWTP – Equipment/Materials Procured from Lebanon**

| <b>Item Description</b>  |
|--|
| Concrete (Ready-Mix)   |
| Reinforced Steel (Rebars)  |
| uPVC Pressure Pipes, Valves, Fittings, Joints, Adapters, Lubricants, etc...  |
| DI Pipes & Fittings  |
| Sand Gravel Base Coarse  |
| Grating Boards & Stair Treads  |
| Redi Floor Drain +Lubricant + Plug + Coupler + uPVC Pressure Pipes   |
| 200 KVA Transformer  |
| Geotextile for Dewatering + Waterstop Welding Machine + PE Nylon + Construction Materials  |
| Standby Generators (20 KVA), Soundproof Enclosures, and 3" Gas Pump  |
| Flanges & Pipe Adaptors & Manhole Covers   |
| Consumable Materials and Hand Tools and Chain Link Fence   |
| SS Metal Fabrications  |
| Dewatering System: materials (bridge support, planks, pumps, pipes, hoses, fittings, etc..), Site Materials, Site Tools, Jobsite Office Furniture, Electrical Fittings, etc... |
| Jobsite Trailer (12m x 3.5m)   |
| Trickling Filter Fans  |
| Hardware (Anchor Bolts, Nuts, etc.), Epoxy Anchoring Systems and Drill Bits  |
| Concrete Manholes, Extensions, & covers  |

|   |
|---|
| Cement  |
| Concrete Admixture + PVC Waterstop + Sealant + Expandable Waterstop + Grout + Floor Hardner & Epoxy + Sikadur + Sikafloor |
| CMU Block + Pipe Connectors   |
| UPVC Pipes & Adhesives  |
| Paint Materials (interior & exterior), uPVC Pipe, Glue, Elbow, Valves, Fittings, and Sanitary Items                       |
| FRP Baffle & Weir Plates  |
| Metal Fabrications: Stands & Supports and Steel Millwright  |
| Toluence & MEK Solvent for TF Media Gluing  |
| Pipes & Elbows  |
| Flexible Ductwork between Fans and TF Walls   |
| Building & Construction Materials (admixtures, waterstops, mould release agent, etc...)                                   |
| Tie Rods and Wing Nuts  |
| Timber (Wood)   |
| Booster Pump for PW Station   |
| Chamfer, Water Barrier Tie-Rod, PVC Tubes for Tie-Rod   |
| Laboratory Equipment  |
| SS Hilti Pins for TF Brackets   |
| Monorail I-Beams  |
| Painting Materials  |
| ABB Electromagnetic Flowmeter   |
| A/C Units- Westinghouse   |
| Electrical Supplies, Components, and Accessories  |
| Base Coarse & Crushed Sand & Blocks   |
| Earthing/Grounding Materials and Single Pole Modular Surge Protection Fuses   |
| A/C unit, Water Cooler, Microwave, Refrigerator (for Jobsite Trailer)   |
| Tiles & Thresholds for Admin Bldg   |

|                          |
|--------------------------|
| Steel Hauling Tank       |
| Miscellaneous Materials  |
| <b>Total = \$681,013</b> |

Total equipment and materials procured for the Ablah WWTP is \$1,275,774.

ALL Equipment and Materials manufacturers, vendors, and suppliers have been paid in full.



## Section 5      Quality Control Management

The approved Quality Management Plan for this project was implemented throughout the project lifecycle. Complete and open communications among project parties and stakeholders were crucial for the success of this important project(s).

During the pre-construction activities, quality control involved:

1. **Value Engineering (VE)**—analyzation, incorporation, and approval of design changes with the concurrence of USAID. CDM Smith endeavored to find ways to complete the projects within USAID's available budget and result in cost savings through VE.
2. **Request For Information (RFI)**—in some cases, CDM Smith construction team would request formal RFIs to CDM Smith International Technical Committee and Dar Al-Handasa for clarifications.
3. **Submittals and Shop Drawings Review**—submittal documents including design drawings, specifications, shop drawings details, samples, and mock-ups from subcontractors, vendors, manufacturers, and suppliers were submitted to CDM Smith for review and approval.
4. **Witnessing Media Tests**—CDM Smith sent a representative to witness the trickling filter pvc media module testing in compliance with the sales agreement and specification requirements, and per Specification Section 133224-3.02-B utilizing the Brentwood Industries testing facility in the States.

Quality Control (QC) during construction involved following CDM Smith Construction Field Management guidelines. For this project, the general requirements for quality control in each construction division have been modified to be project specific. The day-to-day QC implementation for this project included:

1. inspections during the performance of the work and a final inspection upon completion of tasks. Inspection forms are maintained for this project.
2. daily job reports were used and maintained to document the project construction aspects, including but not limited to: resources (labor force and equipment) as well as materials.
3. materials and laboratory testing on site and in specialized laboratories
4. maintained a non-compliance to record deficiencies requiring corrective action to remedy the condition in accordance to contract documents.
5. periodic construction site meetings which is used to communicate construction and design issues, address alternatives in material, equipment and layout, update status of schedule and cost estimates, as well as in-country labor issues, and any other issues or barriers.
6. maintained a set of record drawings to document any deviations between the design drawings and the actual installed conditions in the field.
7. site safety management which resulted in minimizing the injuries and accidents during construction activities.

## Section 6 Project Closeout and Logistics

The main elements of the project closeout plan are outlined here below.

### Technical Matters

- Completed all the construction and enhancement works per the most recent contract modification no.9, signed on December 22<sup>nd</sup>, 2011 before July 31<sup>st</sup>, 2012.
- Completed 'Tests on Completion' for the Ablah wastewater treatment plant (WWTP). *Note: this activity was put on hold due to unavailability of operators by the beneficiary municipalities of Ablah WWTP. Based on USAID COTR instructions, CDM Smith went ahead and operated the facility for treatment of raw sewage starting April 30<sup>th</sup>, 2012 until July 25<sup>th</sup>, 2012.*
- Completed clearance of the final shipment from the US for the farm tractor and slide gates before July 25<sup>th</sup>, 2012.
- Ensured submission of all deliverables, including but not limited to: (1) project manuals for the three wastewater treatment plants (Aitanit, Fourzol, and Ablah) and (2) project Final Report to USAID.

### Financial - Management of Funds

- Completed all project services up to July 31<sup>st</sup>, 2012.
- Closed all expatriate local expenses up through July 31<sup>st</sup>, 2012, including household effect (HHE) shipments, return airfare and excess baggage.
- Paid all invoices for vendors, suppliers, and subcontractors up through July 31<sup>st</sup>, 2012.
- Submitted to USAID Final VAT Tax reporting.
- Submitted to USAID final voucher (SF-1034) when all local direct, all travel costs (end of assignment flights, shipment of household effects out of Lebanon, USA household effects final storage and move out costs, etc.) are posted.
- Submitted a Contractor's Release Form SF 1420 - 40 that indicates our estimate of potential indirect costs adjustments. Additionally, submitted other closeout information such as our certifications that all reports, property had been turned over along with a closeout information sheet by July 31<sup>st</sup>, 2013.
- Will submit to USAID a Final Invoice for the closeout of indirect costs upon approval by USAID to the adjusted NICRA rates of CDM Smith.

### Human Resources Close Out

#### *For Expats:*

- Planned departure dates out of Lebanon, and made travel arrangements and notified USAID accordingly.
- Booked COP exit interview with USAID Lebanon and officially notified departure dates.

#### *For Local Staff:*

- Employment termination – benefits, severance following local labor laws.
- Drafted and distributed “Certificates of Service” to local staff.
- Personnel files – archived, secured, and shipped back to CDM Smith headquarters in the USA.
- Ensured that each staff member understands his/her obligation to the confidentiality of USAID Project and company info, data and documents.

### Property Management

- Discussed and determined the final destination of the equipment and assets with USAID.
- Obtained a receipt certification from each recipient (USAID’s designated recipient) confirming receipt of disposed items.
- Prepared all necessary documentation for transferring of vehicles and termination of auto insurance.
- Reviewed purchase orders files- ensuring completeness and propriety of filing.
- Office rent and utilities – documented and made final payments, as well as turned over facilities to the original landlord.
- Notified service providers (IT, internet, office supplies, equipment maintenance, audit firm, attorney, insurance, security, parking etc) of completion of project and expected departure from country.
- Deleted all CDM Smith proprietary files and information permanently from computers/cell phones that will be turned over to other recipients.

### Program Management

- Submitted this final project report, including lessons learned and recommendations to USAID and to Development Experience Clearinghouse (DEC).
- Communicated with key stakeholders and beneficiaries in the communities about project completion and closeout and obtained their feedback on CDM's performance.

### Record Keeping

Please refer to section 7- Project Records and Documentation below for more information on record keeping.

## Section 7 Project Records and Documentation

Efficient records management is critical to the success of any project. Throughout the implementation of the contract, CDM Smith kept a well-documented filing system for all aspects of the project.

The project records are sorted into main filing categories which included the following:

- Contract Documents
- Project(S) Manuals
- Progress Reports
- Job Orders
- Submittals
- Project Invoices
- Meeting Minutes
- Dar Al-Handasa Consultants
- Bid Packages and Request For Proposals (RFPs)
- CDM Smith Local Subcontractors
- CDM Smith Suppliers & Vendors
- Documents related to Local Lebanese Authorities and Municipalities
- Quality Control Management Documents
- Specification, Drawings, and Geotechnical Reports
- Submittals and Shop Drawings
- Accounting Files and Documents
- O&M Manuals and Spare Parts
- Advise & Assist Documents
- CDM Smith Design Files

Upon the completion of the project, and during the project closeout stage, CDM Smith had packed all the project files into numbered boxes and had created a file index of all the project archived files. The project files, including the accounting documentation shall be archived for at least 3 years from project completion date.

## Section 8 Lessons Learned and Recommendations

*Sustainability of Constructed Infrastructure*, in the narrow sense of preparing village municipality O&M staff to manage the day-to-day responsibilities for wastewater service delivery for the three constructed WWTPs (Aitanit, Fourzol, and Ablah), these objectives have been addressed and met through the Project Advise and Assist Training Program which delivered technical training, O&M systems, and maintenance procedures. The project overall assumptions of designing and constructing, appropriate technology wastewater treatment systems capable of being operated and maintained by local village municipality staff has come true.

In the broader sense, and outside the scope of this SVWWTs project, achieving self-sustaining local village wastewater treatment systems capable of collecting user service fees, retaining, budgeting, and managing resources has not yet occurred. Potential future strategies to be considered in the next generation of project designs and/or follow-up activities to this Project are discussed below.

### 8.1 Lessons Learned

- Proper analyses must be done early on in project performance so that the most technically appropriate and cost-effective options are selected.
- Information must be field verified before study/design can proceed, because information provided by local stakeholders are included in files, and from secondary sources, it is frequently incorrect and/or incomplete.
- Technical innovation can result in complex and difficult to operate facilities – project-appropriate technology is needed for successful project performance.
- Land is expensive, and gaining control of land can be problematic – but adequate land is critical for construction of water/wastewater facilities.
- Lebanon electrical grid power supply is unstable (critical swings in delivered voltage) and unreliable (may be off-line for up to 14-hours per day). Electrical equipment (control panels, electric motors, switchgear) shortened life and early fatigue are certain to occur.
- Water demands and wastewater flows that are to be treated vary greatly due to seasonal population variations – which is potentially problematic when managing water supply demand.
- Find ways to reduce energy and O&M costs – for cost-effective, simple and sustainable water/wastewater systems.
- High efficiency equipment can be unreliable and difficult to repair; specialized equipment can be costly to repair, and require offshore parts; automated equipment can be costly to purchase, difficult to control, hard to repair and have high energy consumption.
- WWTP energy costs (electrical grid power plus diesel fuel used for standby onsite power generation) makeup about 70% of the total operating costs. Having near constant electric grid power supply will reduce total operating costs by half.

- Household septage waste disposal (commercial waste haul tanker dumping) at village WWTPs is happening but remains mostly unregulated allowing unscrupulous waste haulers to continue the practice of direct river discharge even when within the close proximity of a WWTP with septage receiving facilities.
- O&M programs which build on local management structures have better prospects for sustainability than those which establish new or parallel structures.
- The capacity of newly established village wastewater utilities to manage new structures, systems, ideas and funds is low.
- Ministry of Environment (or any other governmental agency) oversight monitoring of treated sewage effluent water quality is not happening which contributes to an attitude of unconcern by village municipality staff regarding WWTP performance and achieving treated water quality standards for direct river discharge.
- Support the Project even in times of conflict and/or project disruptions that have the potential to impact project schedule – so that the project maintains its schedule to the extent possible and is performed successfully.
- Local Lebanese subcontractors are frequently unfamiliar with U.S. quality standards and QA/QC procedures and testing that are expected of them.

## **8.2 Recommendations**

- When collaborating with the four Water Establishments in Lebanon, collect as much information as possible and analyze needs and issues that the wastewater sector face, to determine best value selection, most efficient project delivery approach, and procurement methods that meet performance requirements – to ensure sustainable solutions.
- Visit and survey each site to obtain actual measurements and data to verify the information provided by others, including running tests as necessary and collecting actual field data to verify site conditions before proceeding to detailed design.
- Harness technical innovation to create lowest possible cost and low O&M solutions that still are project/context appropriate.
- Consider wastewater treatment processes that account for variable flows and systems for management of water supply demand.
- Consider increased capital investment to reduce O&M costs later.
- Select equipment based on reliability and reduced O&M costs which can be repaired locally. In addition, consider manual operations to reduce maintenance and energy costs.
- Look for ways to continue capacity building efforts for village municipality WWTP O&M staff so that already learned skills and procedures will not be lost due to lack of municipality management and government watchdog agency oversight.
- Private sector local service companies should be considered as an alternative to village direct hired O&M staff working at new WWTP facilities.
- USAID to consider providing assistance to Lebanon decision makers regarding standards and regulations for reuse of reclaimed wastewater.

- Look for Ministry of Agriculture laboratory facilities (Bekaa region near existing WWTPs) which can support village WWTPs by providing analysis of water quality samples.
- WWTP biosolids from sludge drying beds provides an opportunity for co-composting with local agriculture waste trimmings to produce a better and safer reusable biosolids product.
- Set procedures in place to support the Mission while maintaining safe conditions for all project personnel. These procedures include utilizing the services of local staff and resources during major security disruptions in-country.
- Educate and mentor subcontractors on means and methods in achieving high quality works during the implementation of the work plans. Detailed specifications and BoQs will present the course for quality testing procedures that the local subcontractors must follow.
- Support public awareness programs to inform the public (target villages) on environmental issues and why wastewater treatment is important to the community. The objective is that through better understanding of the health and environmental problems of wastewater there will be more public will be more willing to invest in sustaining the WWTPs.
- Early on in a project engage the utility management group and provide management and financial training to enhance their ability to sustainability manage the wastewater facilities.