

A.V.S.I. Associazione Volontari per il Servizio Internazionale

L.R.A. Litani River Authority

STUDIO ASSOCIATO Ingegneria Architettura Urbanistica - Morazzone (VA) Italy

IRWA

Improvement of Irrigation Water Management in Lebanon & Jordan

FINAL REPORT

Rehabilitation of the River Litani and the affluents

Lebanon

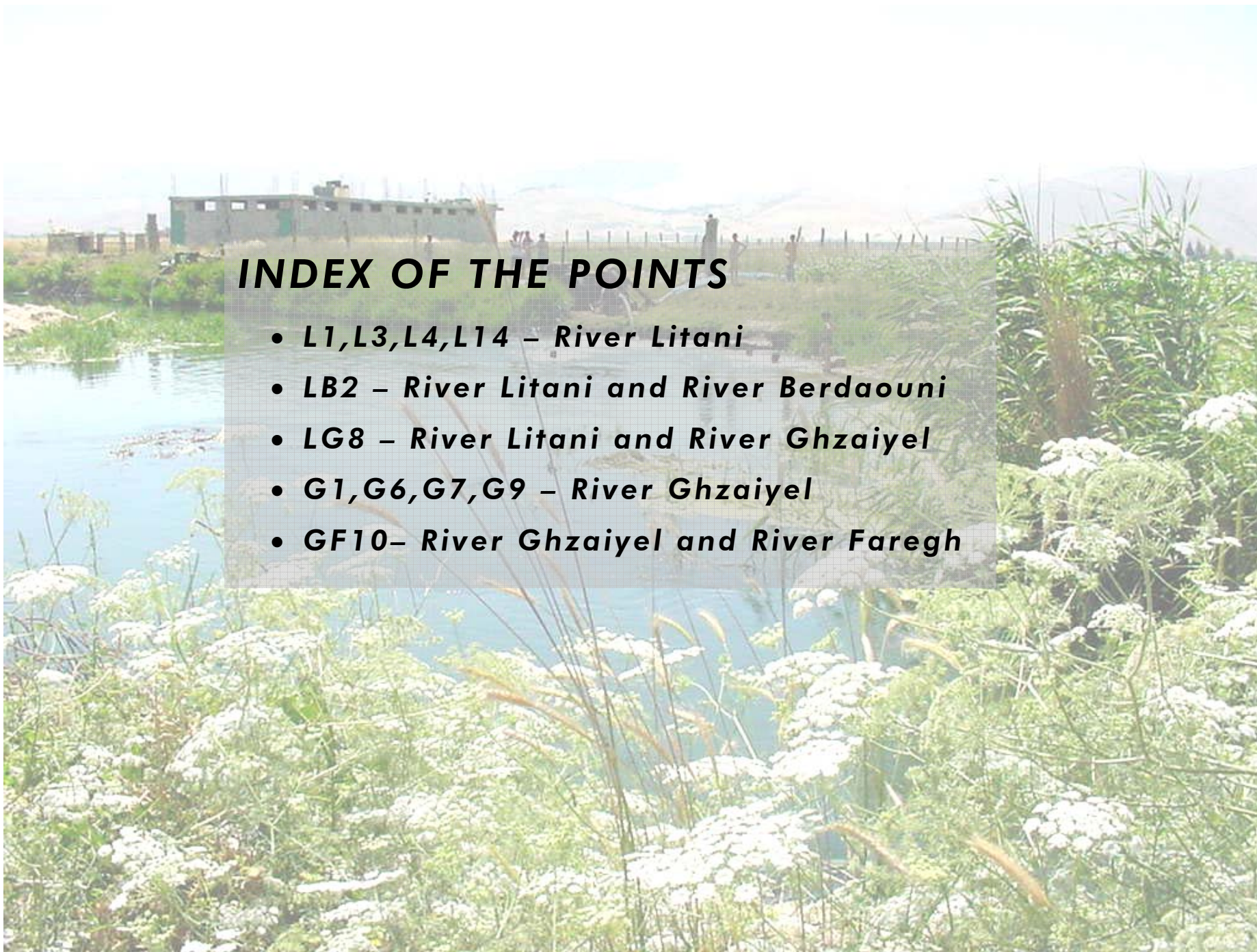
Bekaa Valley

2003 ÷ 2007

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INDEX OF THE POINTS

- ***L1,L3,L4,L14 – River Litani***
- ***LB2 – River Litani and River Berdaouni***
- ***LG8 – River Litani and River Ghzaiyel***
- ***G1,G6,G7,G9 – River Ghzaiyel***
- ***GF10– River Ghzaiyel and River Faregh***

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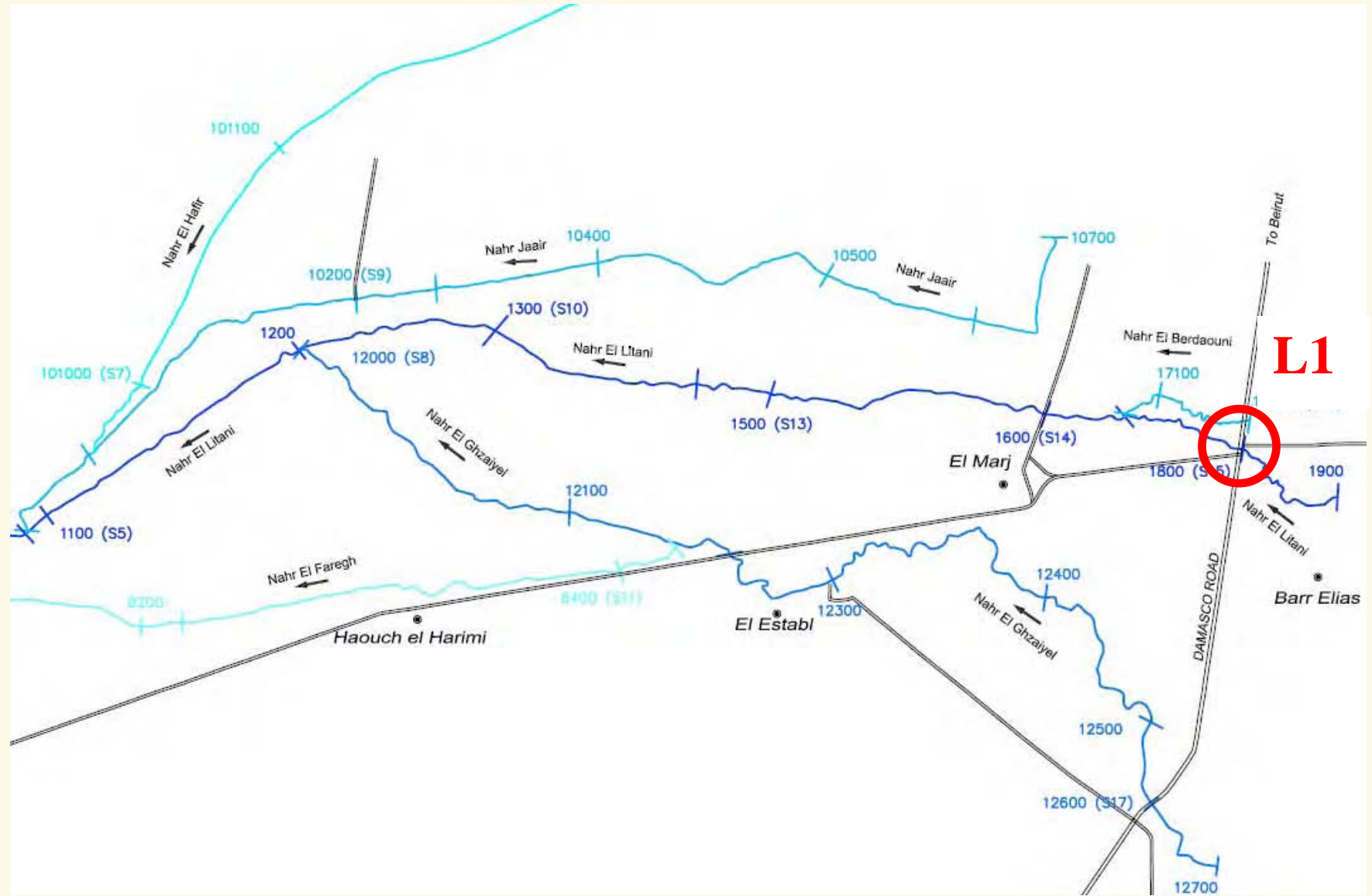
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LOCALIZATION OF THE PLAN AREA

Reference Data: Litani River, L1 POINT



EVALUATION OF THE JOBS

Reference Data: Litani River, L1 POINT

Photo



Explanation

The situation of the Litani River in L1 point before the jobs were characterized by a complex condition. The river was encircled from the buildings. This point is very important because is located on the Damascus road and near to the houses. The bed of the river in proximity of the bridge was tall due to the solid deposition and the uncontrolled discharge of garbage, this limits the flow that could pass trough the bridge. The bridge is also characterized by the presence of pipages hung to the deck.

BEFORE THE WORKS

EVALUATION OF THE JOBS

Reference Data: Litani River, L1 POINT

Photo



Explanation

During the works, according to the preliminary hydraulic evaluation we recalibrate the river section cleaning the section of the river under the bridge.
We model new river banks with appropriate inclination (1:3) compatibly with the new protections.
We Execute gabions mattresses and geocomposite.

DURING THE WORKS

EVALUATION OF THE JOBS

Reference Data: Litani River, L1 POINT

Photo



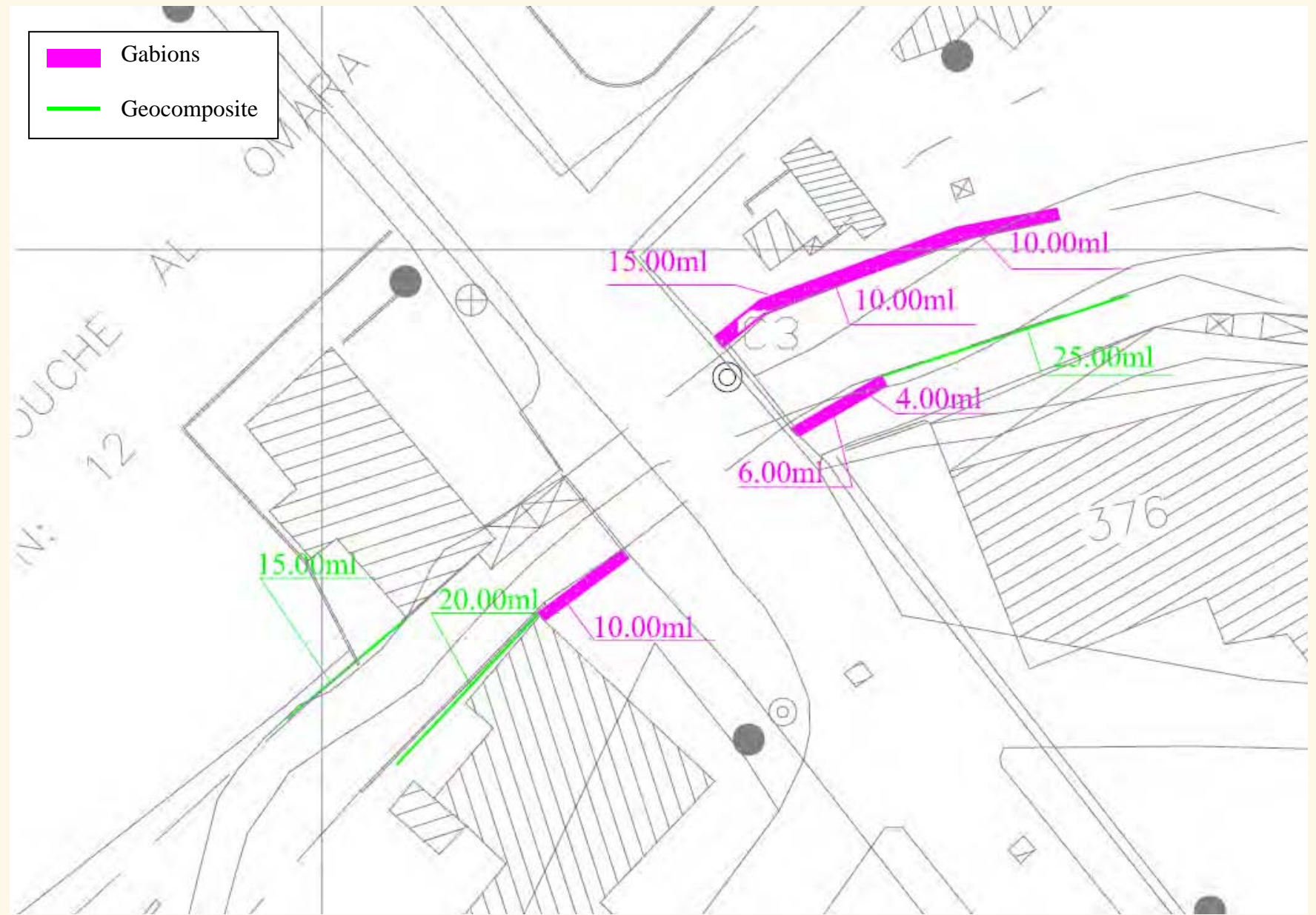
Explanation

The works completed according to the project previsions have concurred to reach better conditions for the river flows.
 The recalibration of the river bed and banks have granted safer condition for the bridge increasing the potential maximum river flow.
 The new protections (gabions and geocomposite)of the river banks are more sustainable and permit a simple maintenance.
 The houses and the Damascus road are safer from the floods.

AFTER THE WORKS

PROJECT PLAN

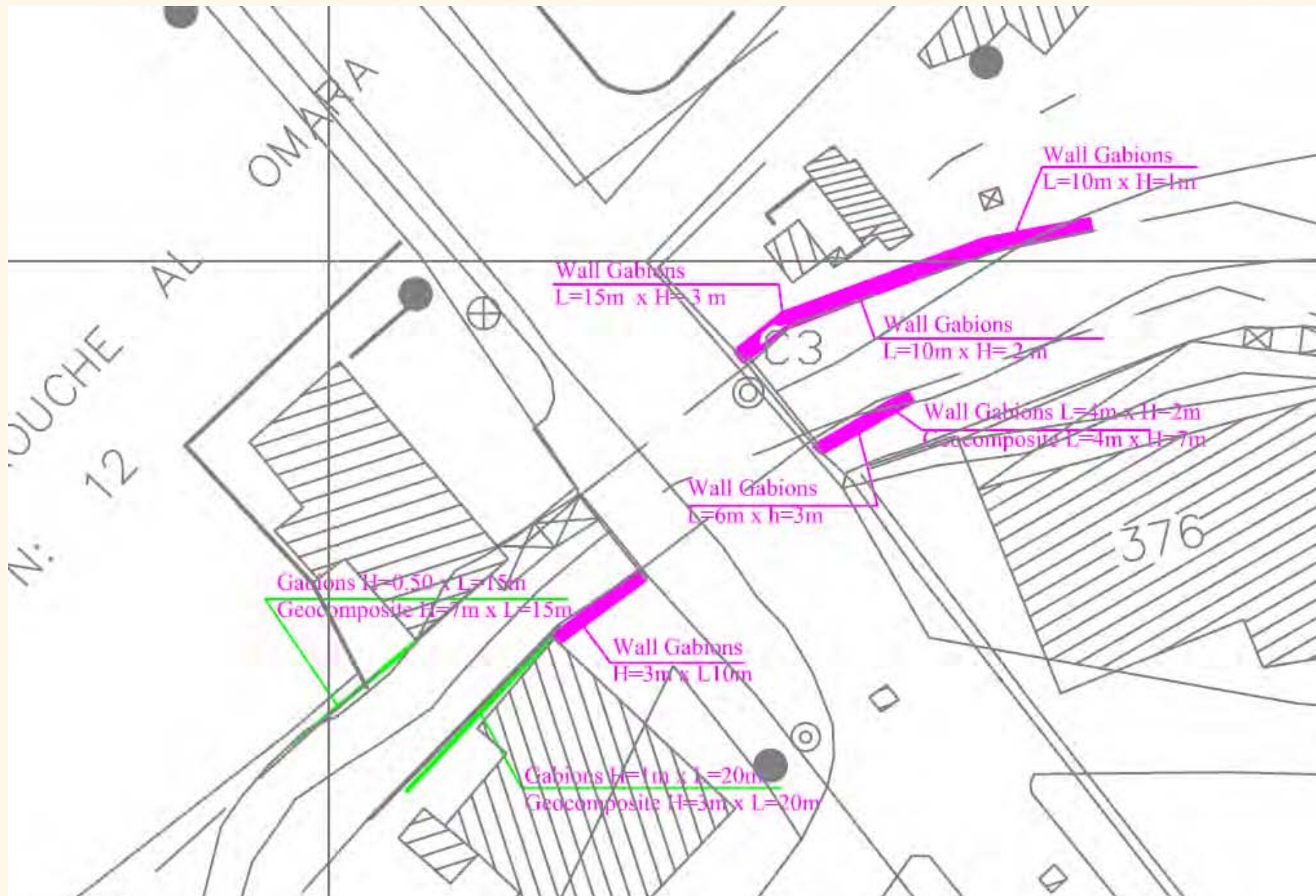
Reference Data: Litani River, L1 POINT



AS - BUILT CONDITIONS

Reference Data:

Litani River, L1 POINT



FINAL ACCOUNTING

Reference Data: Litani River, L1 POINT

| Site | Description | Qty. Mentioned in B.O.Q | | | Qty. Executed | | | |
|------|---|-------------------------|---------------|---------------|--------------------|---------------|---------------|--------------------|
| | | Unit | Contract Qty. | Unit. Price € | Total € | Qty. Executed | Unit. Price € | Total € Executed |
| L1 | Excavation and earth works | m ³ | 450 | 2,00 € | 900,00 € | 2336 | 2,00 € | 4.672,00 € |
| | Gabbions | m ³ | 228,5 | 47,00 € | 10.739,50 € | 240 | 47,00 € | 11.280,00 € |
| | Mattresses | m ² | 165 | 19,00 € | 3.135,00 € | 240 | 19,00 € | 4.560,00 € |
| | Geocomposite | m ² | 370 | 12,80 € | 4.736,00 € | 476 | 12,80 € | 6.092,80 € |
| | Geotextile | m ² | 450 | 1,00 € | 450,00 € | 424 | 1,00 € | 424,00 € |
| | <u>Addendum to site L1</u> | | | | | | | |
| | • Rocks Laid as foundation under the Mattresses | m ³ | | | | 45 | 25,00 € | 1.125,00 € |
| | • Drainage Box culverts | L.s | | | | 2 | 1.000,00 € | 2.000,00 € |
| | • Pannel Board | L.s | | | | 1 | 350,00 € | 350,00 € |
| | TOTAL EURO SITE L1 | | | | 19.960,50 € | | | 30.503,80 € |

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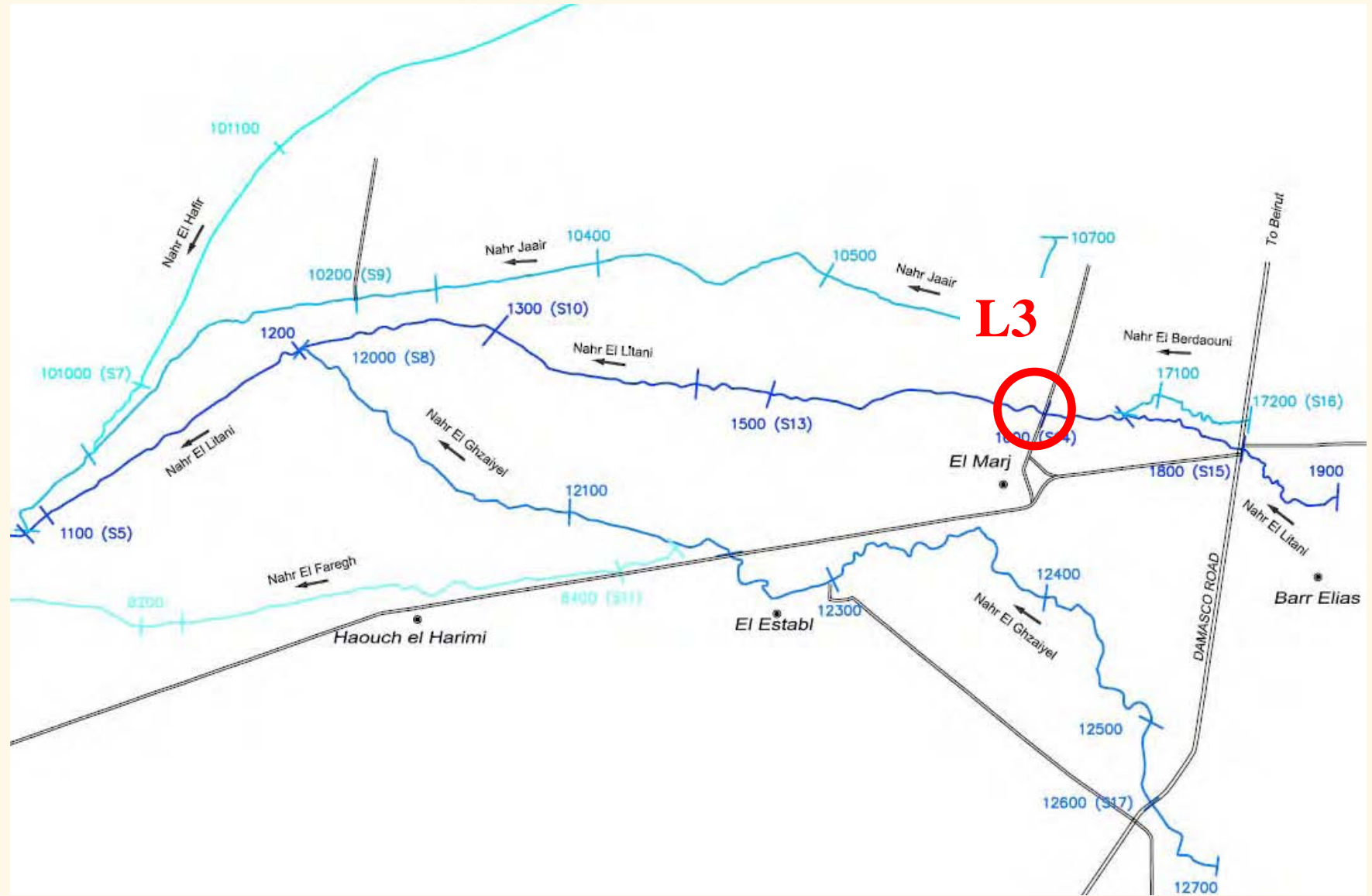
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LOCALIZATION OF THE PLAN AREA

Reference Data: Litani River, L3 POINT



EVALUATION OF THE JOBS

Reference Data: Litani River, L3 POINT

Photo description



Explanation

The situation of the Litani River in L3 point before the jobs were characterized by a complex condition. The area was characterized by several episode of flood with damages for the private properties, agricultural area and problems for the road circulation. This causes danger because the connection with other villages was so difficult. The bed of the river in proximity of the bridge was tall due to the solid deposition, and also the bridge was characterized by the presence of pipages hung to the deck. This limits the flow that could pass trough the bridge and causes the floods.

BEFORE THE WORKS

EVALUATION OF THE JOBS

Reference Data: Litani River, L3 POINT

Photo description



Explanation

During the works, according to the preliminary hydraulic evaluation we enlarge the width of the river to 18 m.
We model new river banks with appropriate inclination (1:3) compatibly with the new protections
We Execute 160 m. of gabions & geocomposite for every side of the river, cleaning the bed and recalibrating the banks for approximately 4 Km.
We extend the pipes and create a correct intersection with the river

DURING THE WORKS

EVALUATION OF THE JOBS

Reference Data:

Litani River, L3 POINT

Photo description



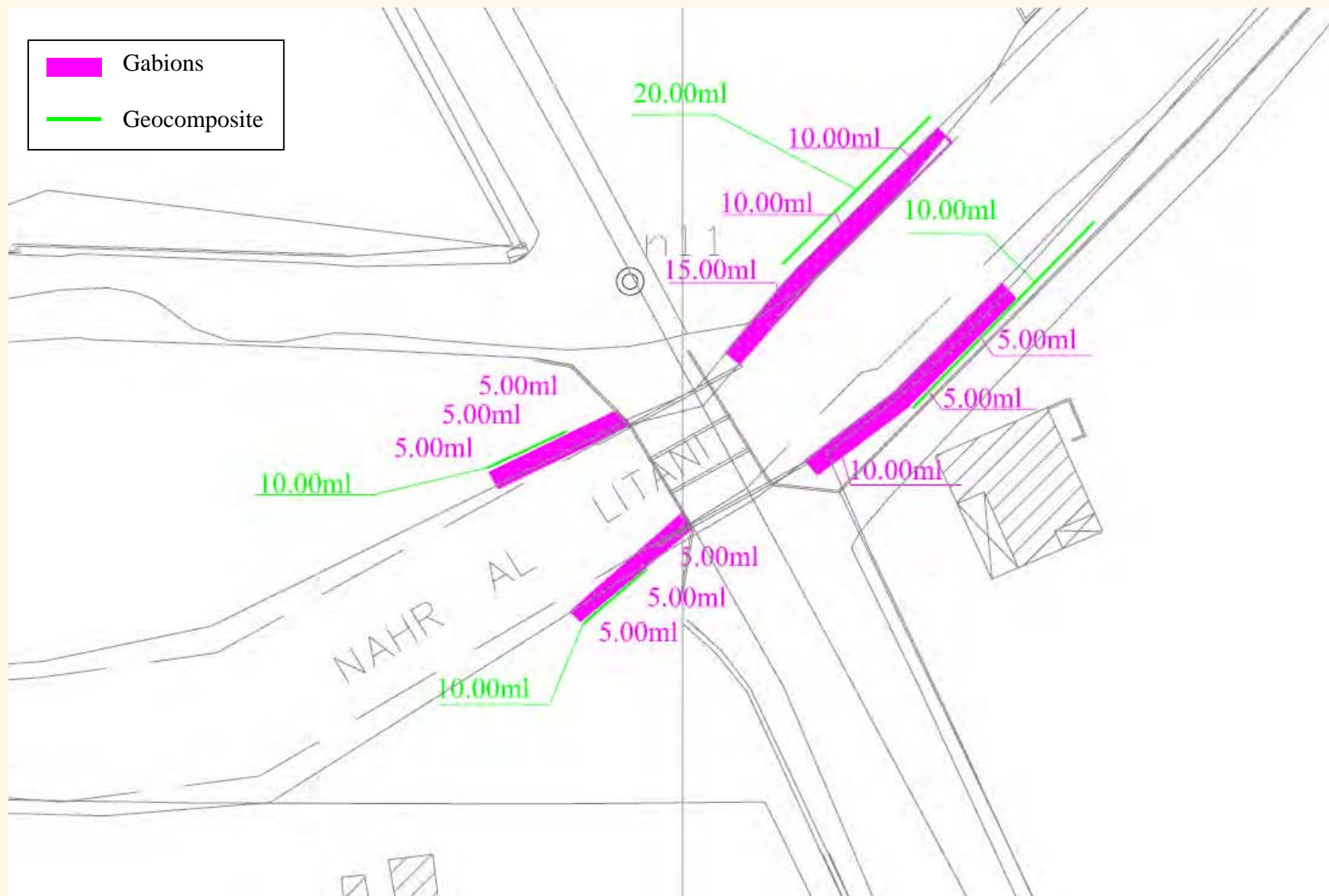
Explanation

The works completed according to the project previsions have concurred to reach better conditions for the river flows.
 The recalibration of the river bed and banks have granted safer condition for the bridge.
 The new protections (gabions and geocomposite) of the river banks are more sustainable and permit a simple maintenance.
 Cultivated lands are safer from the flooding and

AFTER THE WORKS

PROJECT PLAN

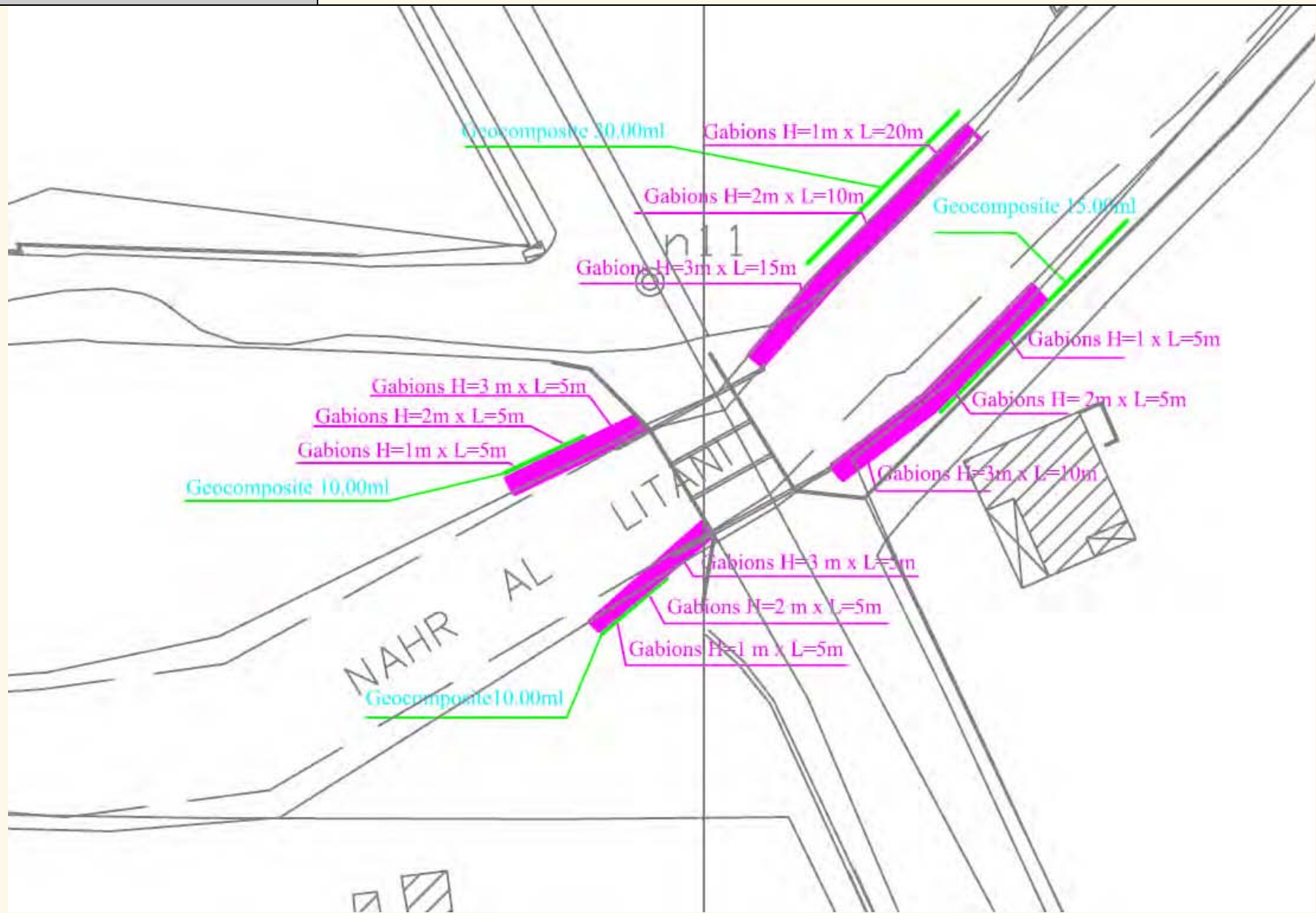
Reference Data: Litani River, L3 POINT



AS - BUILT CONDITIONS

Reference Data:

Litani River, L3 POINT



FINAL ACCOUNTING

Reference Data: Litani River, L3 POINT

| Site | Description | Qty. Mentioned in B.O.Q | | | | Qty. Executed | | |
|---------------------------|---|-------------------------|--------------|---------------|--------------------|---------------|---------------|--------------------|
| | | Unit | Contract Qty | Unit. Price € | Total € | Qty. Executed | Unit. Price € | Total € Executed |
| L3 | Excavation and earth works | m ³ | 1500 | 2,00 € | 3.000,00 € | 1965 | 2,00 € | 3.930,00 € |
| | Gabbions | m ³ | 275 | 47,00 € | 12.925,00 € | 318 | 47,00 € | 14.946,00 € |
| | Mattresses | m ² | 255 | 19,00 € | 4.845,00 € | 340 | 19,00 € | 6.460,00 € |
| | Geocomposite | m ² | 350 | 12,80 € | 4.480,00 € | 330 | 12,80 € | 4.224,00 € |
| | Geotextile | m ² | 510 | 1,00 € | 510,00 € | 560 | 1,00 € | 560,00 € |
| | <u>Addendum to site L3</u> | | | | | | | |
| | • Rocks Laid as foundation under the Mattresses | m ³ | | | | 54 | 25,00 € | 1.350,00 € |
| | • Pump Usage | hr | | | | 40 | 20,00 € | 800,00 € |
| | • Drainage Box culverts | L.s | | | | 1 | 1.000,00 € | 1.000,00 € |
| TOTAL EURO SITE L3 | | | | | 25.760,00 € | | | 33.270,00 € |

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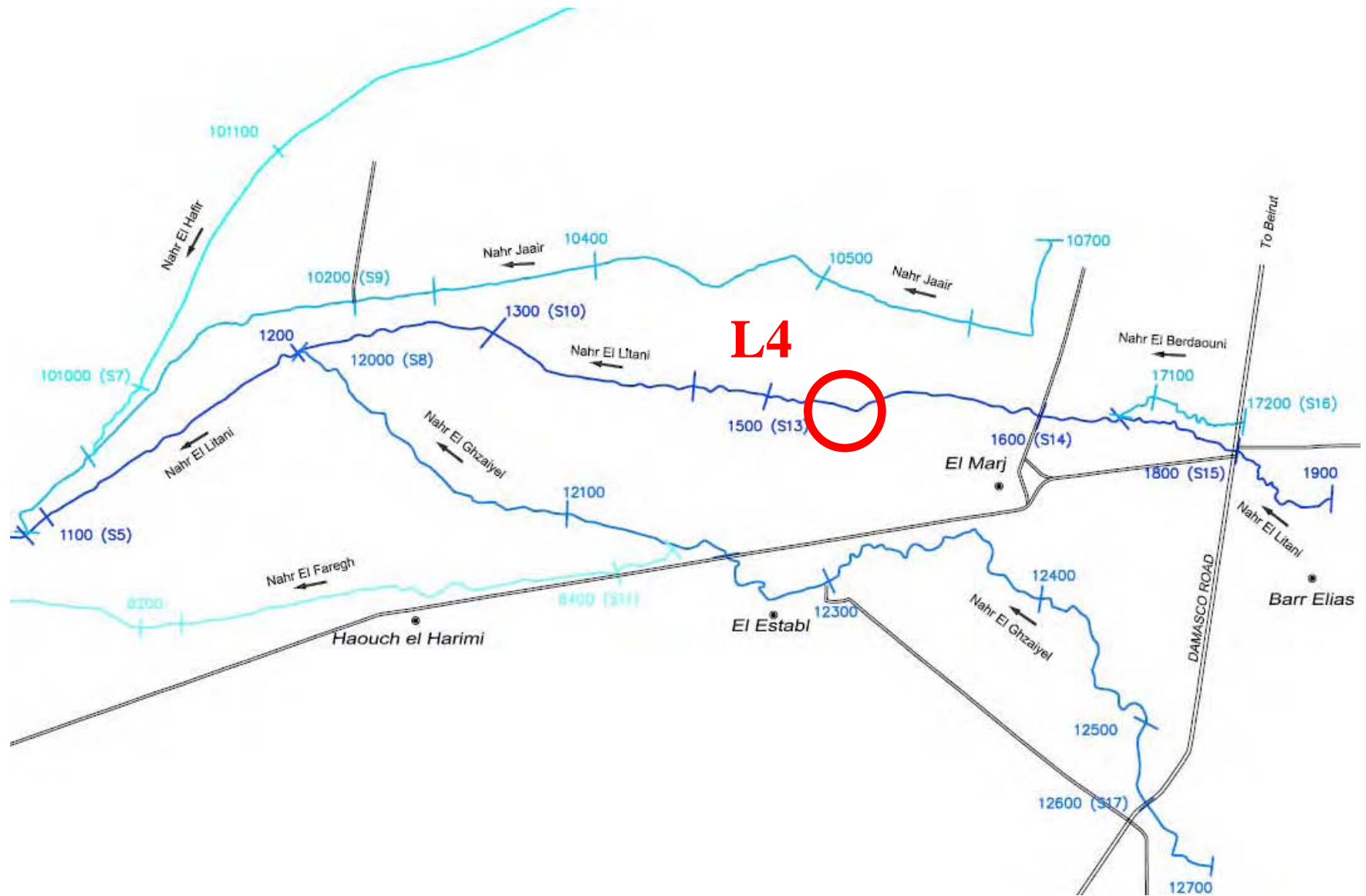
Final Report

LITANI RIVER

L4 point

LOCALIZATION OF THE PLAN AREA

Reference Data: Litani River, L4 POINT



EVALUATION OF THE JOBS

Reference Data: Litani River, L4 POINT

Photo



Explanation

The situations of the Litani River before the jobs were characterized by the needs of a recalibration to regularize the flow and prevent the floods.

BEFORE THE WORKS

EVALUATION OF THE JOBS

Reference Data: Litani River, L4 POINT

Photo



Explanation

During the works, according to the preliminary hydraulic evaluation we have recalibrate the river section for a length of about 4 km

DURING THE WORKS

EVALUATION OF THE JOBS

Reference Data: Litani River, L4 POINT

Photo



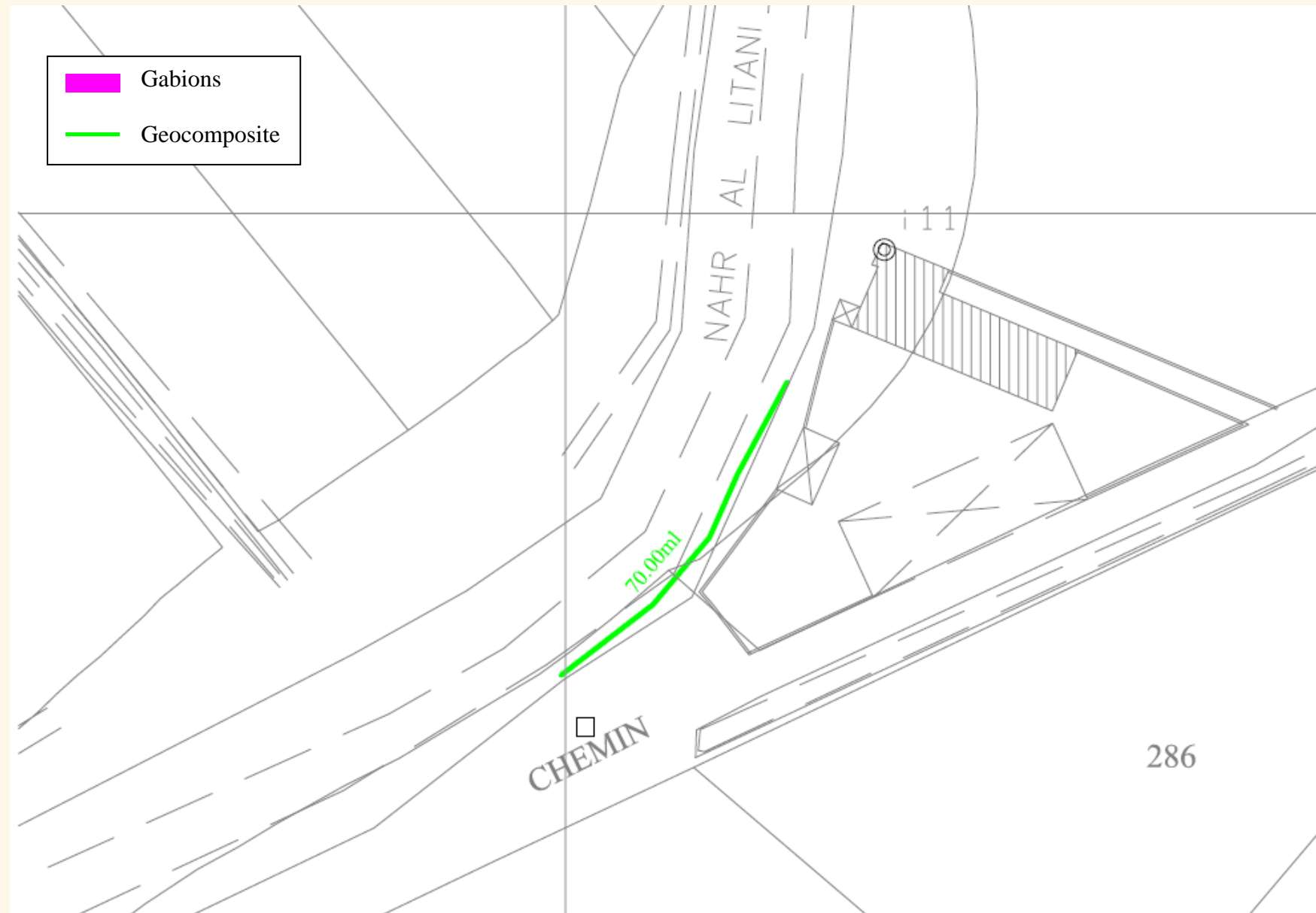
Explanation

After the works we have guaranteed a better flow condition to prevent flood and protect the local activities (cow farm)

AFTER THE WORKS

PROJECT PLAN

Reference Data: Litani River, L4 POINT



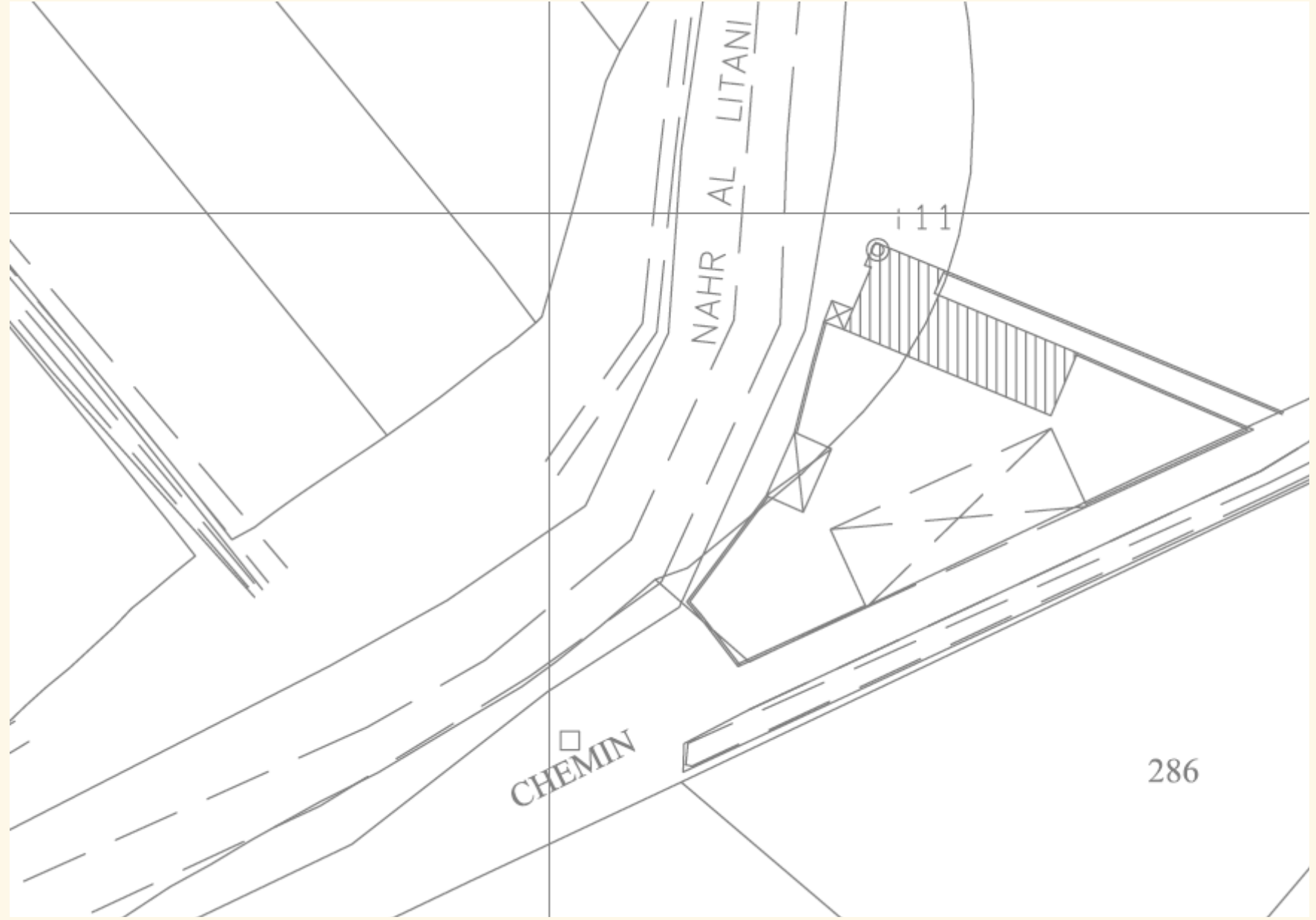
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AS – BUILT CONDITIONS

Reference Data: Litani River, L4 POINT



FINAL ACCOUNTING

Reference Data: Litani River, L4 POINT

| Site | Description | Qty. Mentioned in B.O.Q | | | | Qty. Executed | | | |
|--------------------|----------------------------|-------------------------|--------------|---------------|------------|---------------|--------------------|------------------|-------------------|
| | | Unit | Contract Qty | Unit. Price € | Total € | Qty. Executed | Unit. Price € | Total € Executed | |
| L4 | Excavation and earth works | m ³ | 250 | 2,00 € | 500,00 € | 1650 | 2,00 € | 3.300,00 € | |
| | Gabbions | m ³ | 35 | 59,00 € | 2.065,00 € | 0 | 0,00 € | 0,00 € | |
| | Mattresses | m ² | 0 | 0,00 € | 0,00 € | 0 | 0,00 € | 0,00 € | |
| | Geocomposite | m ² | 490 | 19,00 € | 9.310,00 € | 0 | 0,00 € | 0,00 € | |
| | Geotextile | m ² | 35 | 1,00 € | 35,00 € | 0 | 0,00 € | 0,00 € | |
| TOTAL EURO SITE L4 | | | | | | | 11.882,00 € | | 3.300,00 € |

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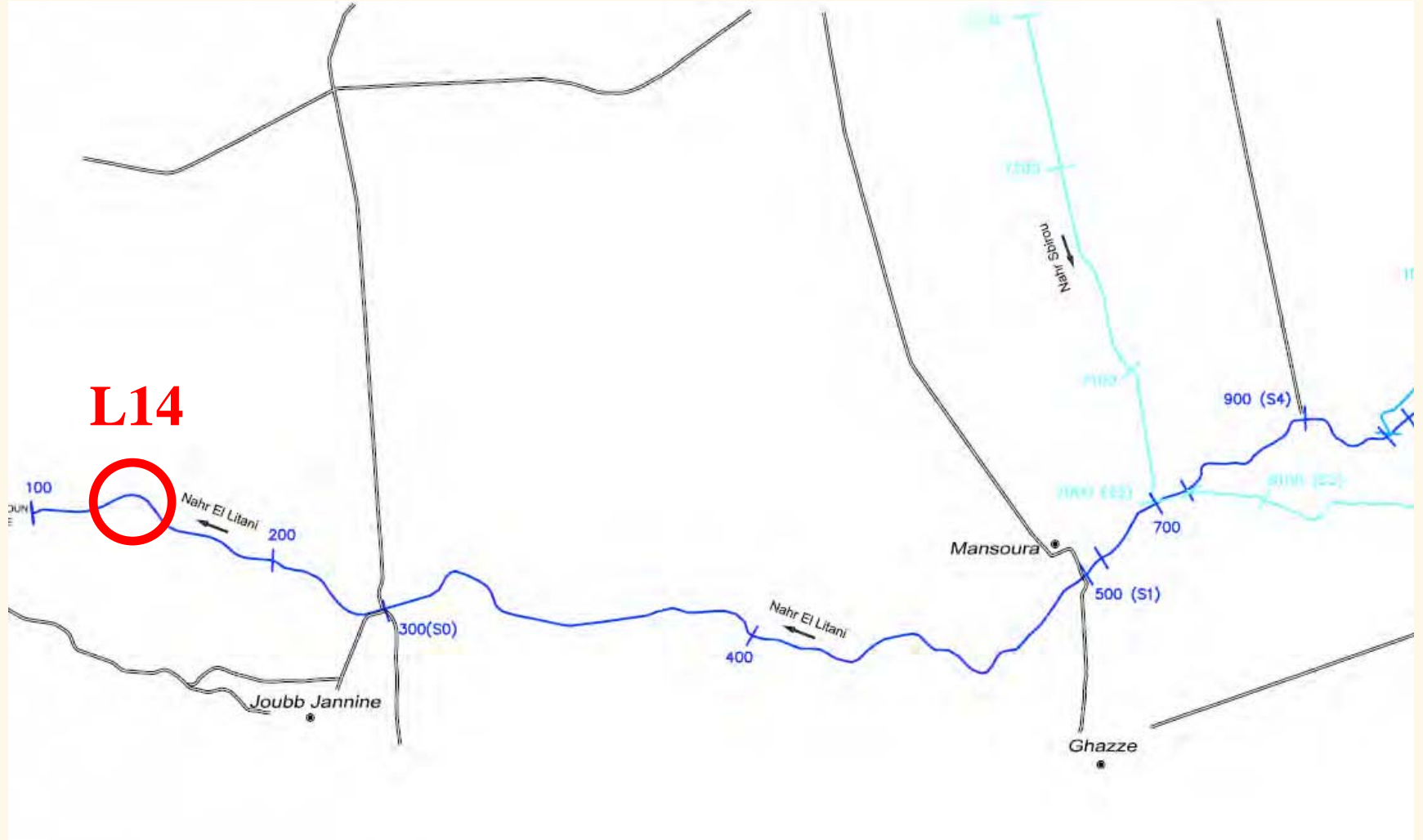
Final Report

LITANI RIVER

L14 point

LOCALIZATION OF THE PLAN AREA

Reference Data: Litani River, L14 POINT



EVALUATION OF THE JOBS

Reference Data: Litani River, L14 POINT

Photo



Explanation

A big area of erosion near the location of the service center in Kherbet Kanafar (IRWA Project) - Works carried out on 2005

BEFORE THE WORKS

EVALUATION OF THE JOBS

Reference Data:

Litani River, L14 POINT

Photo



Explanation

Backfilling the area with rocks as foundation and covered with selected soil. (Volume 6330 m3) - Re-calibration of the banks for 200 Lm.

DURING THE WORKS

EVALUATION OF THE JOBS

Reference Data:

Litani River, L14 POINT

Photo



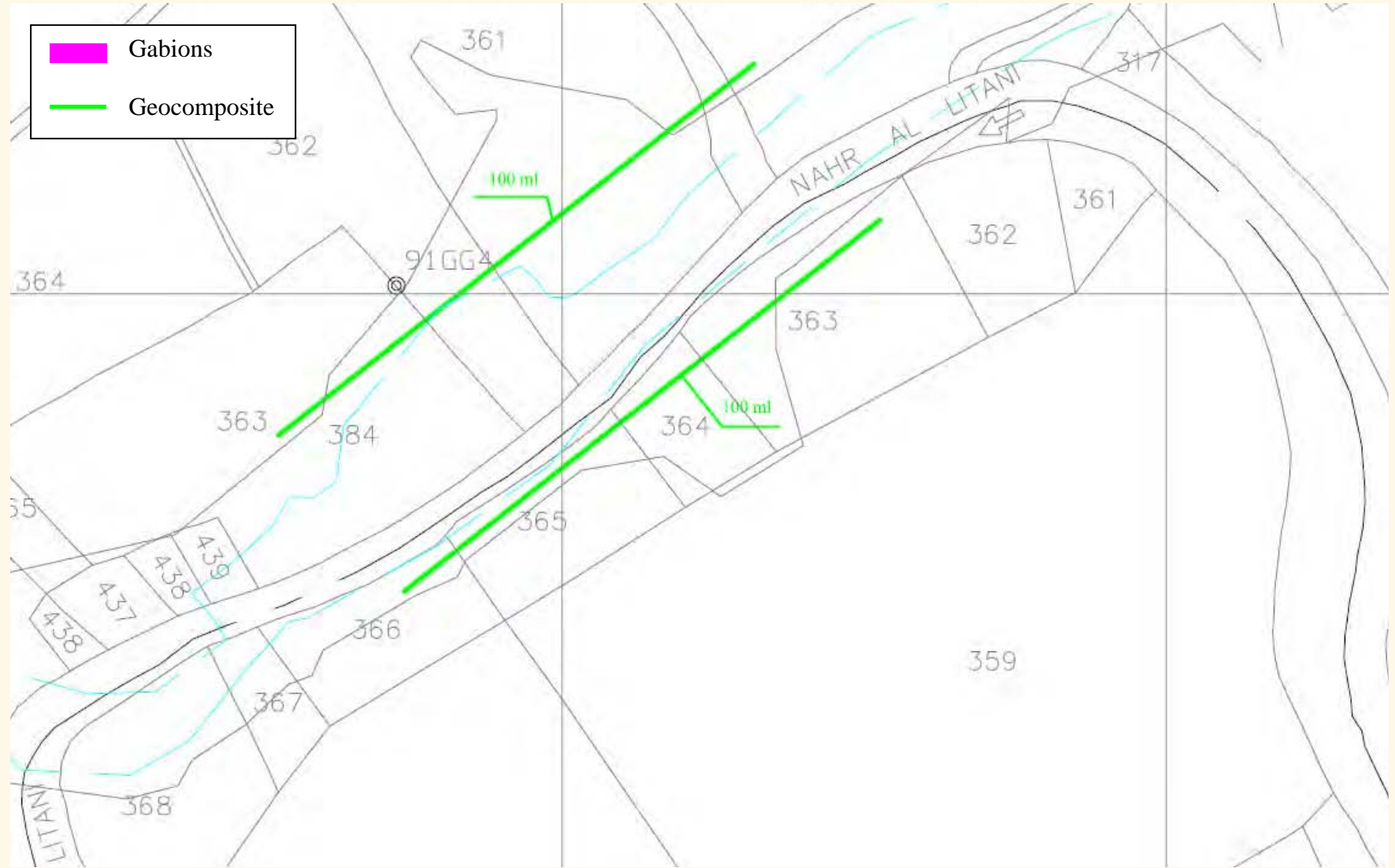
Explanation

The jobs have concurred to arrange the erosion area and to recalibrate the fluvial section to the aim to reduce the flooded areas and consolidate the banks.

AFTER THE WORKS

PROJECT PLAN

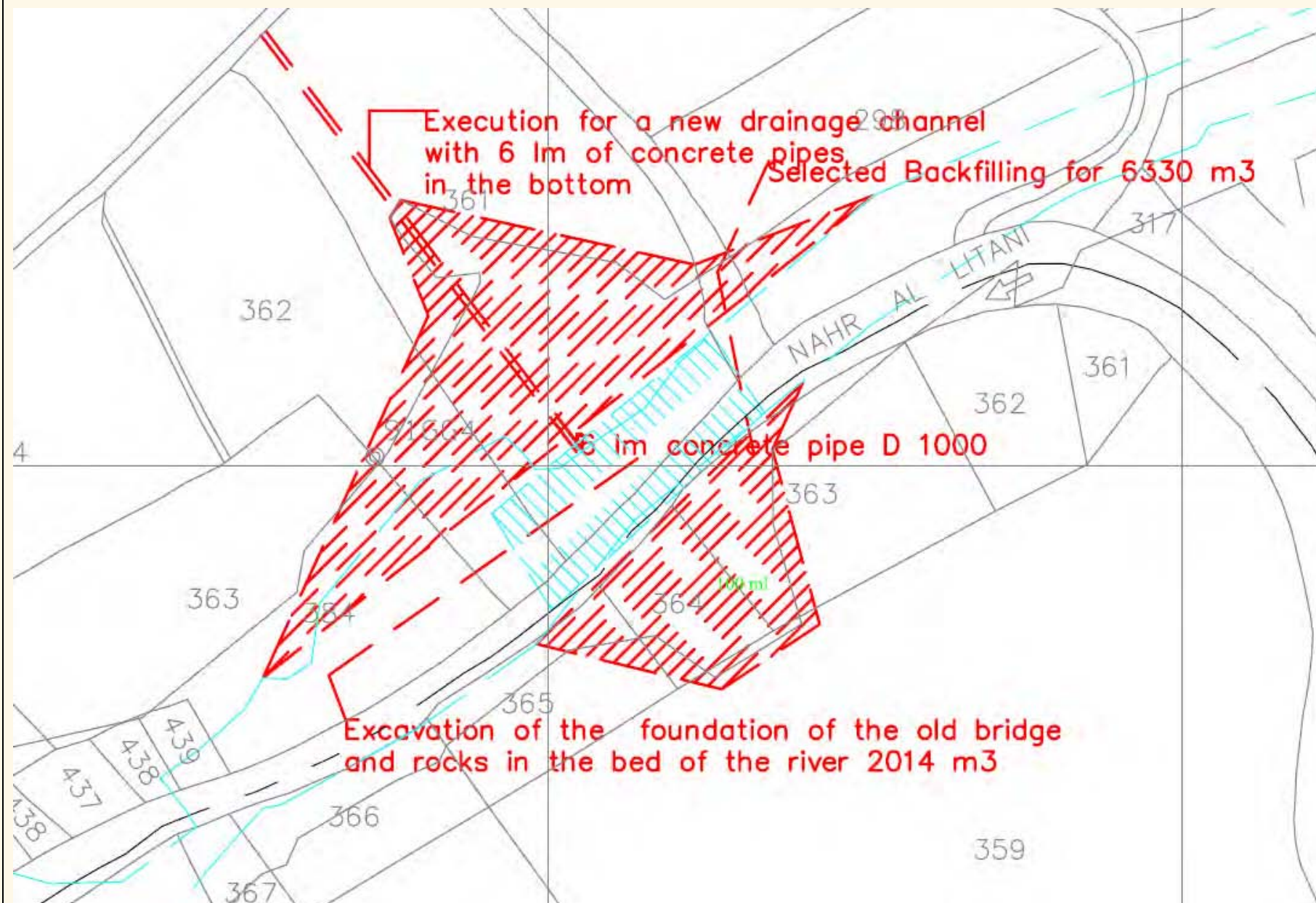
Reference Data: Litani River, L14 POINT



AS - BUILT CONDITIONS

Reference Data:

Litani River, L14 POINT



FINAL ACCOUNTING

Reference Data: Litani River, L14 POINT

| Site | Description | Qty. Mentioned in B.O.Q | | | | Qty. Executed | | |
|------|-----------------------------|-------------------------|--------------|---------------|--------------------|---------------|---------------|--------------------|
| | | Unit | Contract Qty | Unit. Price € | Total € | Qty. Executed | Unit. Price € | Total € Executed |
| L14 | Excavation and earth works | m ³ | 1000 | 2,00 € | 2.000,00 € | 2014 | 2,00 € | 4.028,00 € |
| | Gabbions | m ³ | 100 | 59,00 € | 5.900,00 € | 0 | 0,00 € | 0,00 € |
| | Mattresses | m ² | 0 | 0,00 € | 0,00 € | 0 | 0,00 € | 0,00 € |
| | Geocomposite | m ² | 1200 | 12,80 € | 15.360,00 € | 0 | 0,00 € | 0,00 € |
| | Geotextile | m ² | 400 | 1,00 € | 400,00 € | 0 | 0,00 € | 0,00 € |
| | <u>Addendum to site L14</u> | | | | | | | |
| | • Backfilling | m ³ | | | | 6330 | 6,00 € | 37.980,00 € |
| | • Concrete pipes | l.m | | | | 6 | 27,00 € | 162,00 € |
| | | | | | | | | |
| | | | | | | | | |
| | TOTAL EURO SITE L14 | | | | 23.660,00 € | | | 42.170,00 € |

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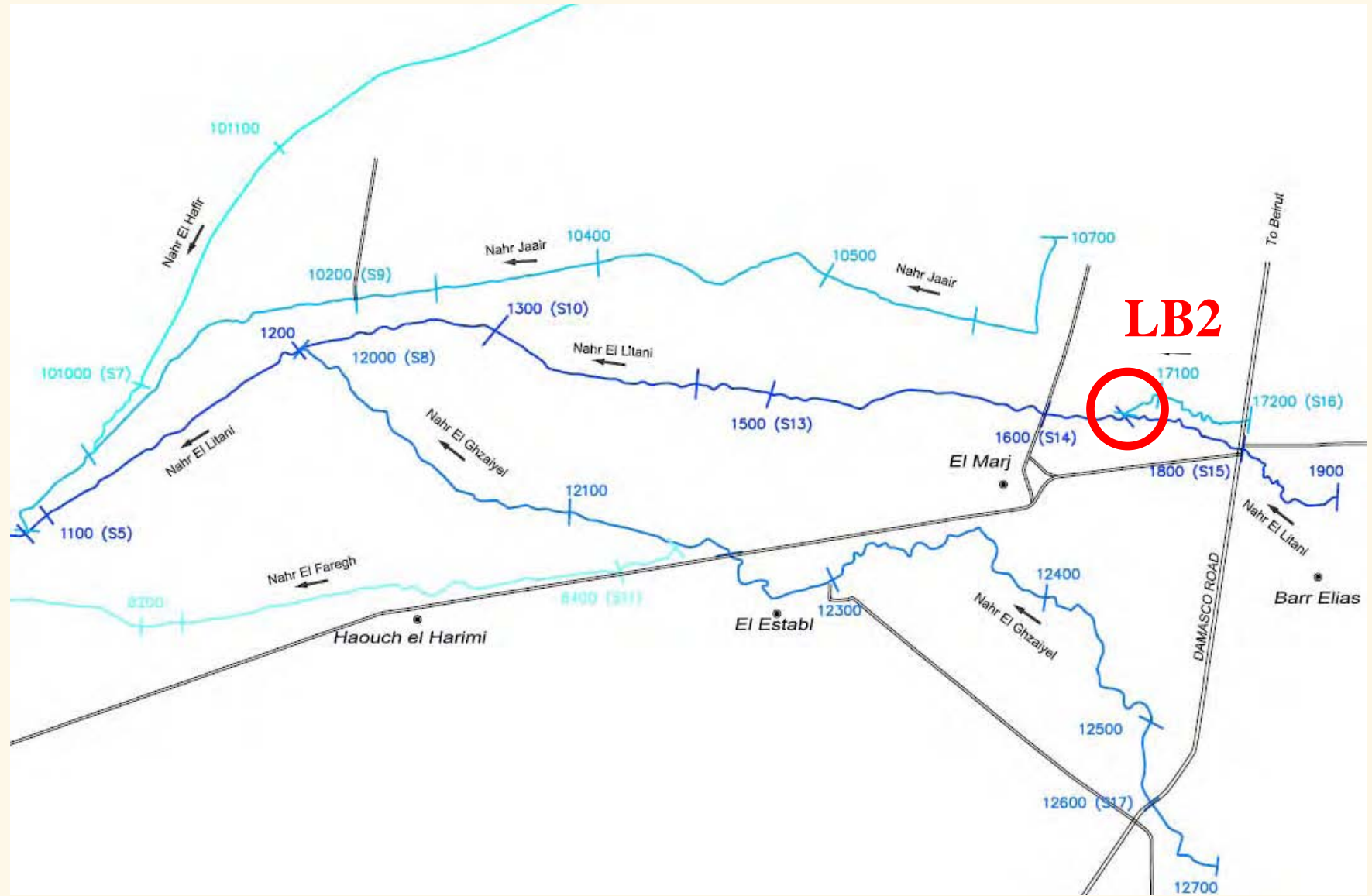
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Final Report
LITANI-BERDAOUNI RIVERS
LB2 point

LOCALIZATION OF THE PLAN AREA

Reference Data: Litani River, Berdaouni River, LB2 POINT



EVALUATION OF THE JOBS

Reference Data: Litani River, Berdaouni River, LB2 POINT

Photo



Explanation

The situations at the confluence of the Litani River and Berdaouni River before the jobs were characterized by river banks without protection and with heavy signs of erosion. Some dams are located in the river obstructing the flow.
 The width of the section was variable and locally was too much low to permit the regular flow of the water in case of peak flows. This situation causes several case of flooding with bad conditions for the agriculture.

BEFORE THE WORKS

EVALUATION OF THE JOBS

Reference Data:

Litani River, Berdaouni River, LB2 POINT

Photo



Explanation

During the works, according to the preliminary hydraulic evaluation we enlarge the width of the river to reach a safer condition of flow. We model new river banks with 3 Km of recalibration. We execute mattresses and gabions with geocomposite on every bank.

EVALUATION OF THE JOBS

Reference Data:

Litani River, Berdaouni River, LB2 POINT

Photo



Explanation

The works completed according to the project previsions have concurred to reach better conditions for the river flows.
 The recalibration of the river bed and banks have granted safer condition in case of flood.
 The new protections (gabions and geocomposite) of the river banks are more sustainable and permit a simple maintenance.
 Cultivated lands are safer from the flooding.

AFTER THE WORKS

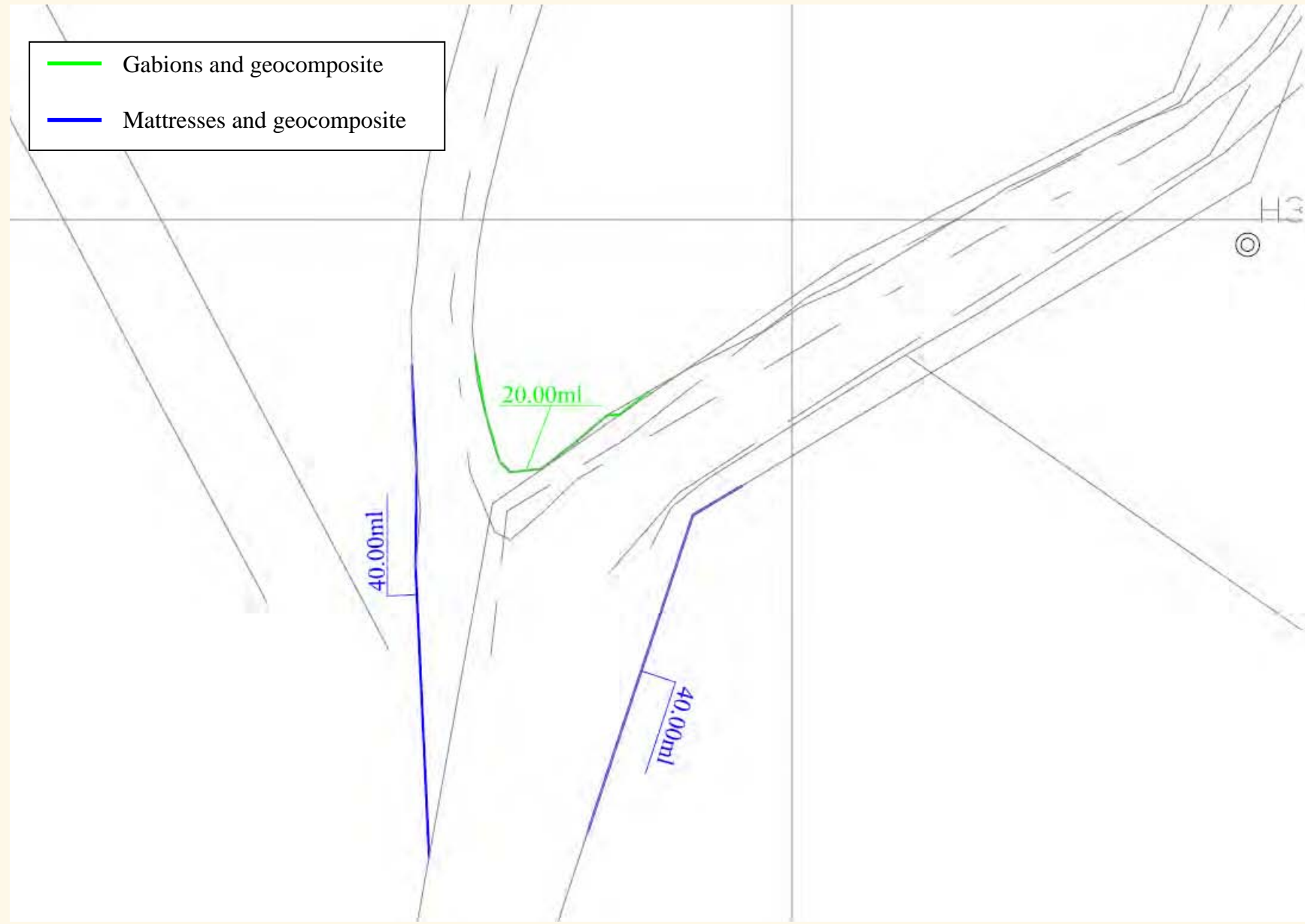
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PROJECT PLAN

Reference Data: Litani River, Berdaouni River, LB2 POINT



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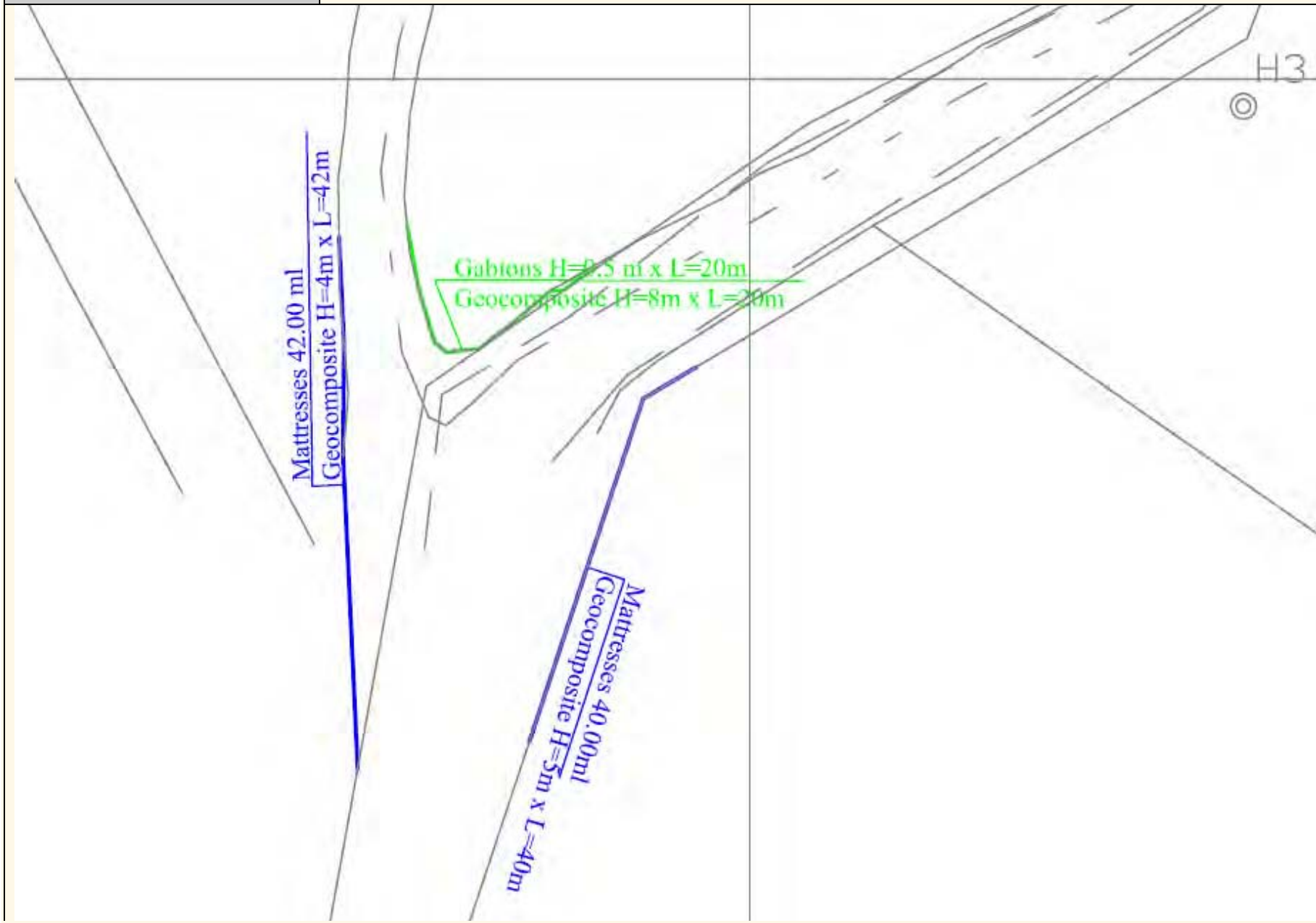
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AS - BUILT CONDITIONS

Reference Data:

Litani River, Berdaoui River, LB2 POINT



FINAL ACCOUNTING

Reference Data: Litani River, Berdaouni River, LB2 POINT

| Site | Description | Unit | Qty. Mentioned in B.O.Q | | | Qty. Executed | | |
|---------------------|----------------------------|----------------|-------------------------|---------------|--------------------|---------------|---------------|--------------------|
| | | | Contract Qty | Unit. Price € | Total € | Qty. Executed | Unit. Price € | Total € Executed |
| LB2 | Excavation and earth works | m ³ | 400 | 2,00 € | 800,00 € | 2283 | 2,00 € | 4.566,00 € |
| | Gabbions | m ³ | 10 | 59,00 € | 590,00 € | 14 | 59,00 € | 826,00 € |
| | Mattresses | m ² | 240 | 19,00 € | 4.560,00 € | 420 | 19,00 € | 7.980,00 € |
| | Geocomposite | m ² | 440 | 12,80 € | 5.632,00 € | 504 | 12,80 € | 6.451,20 € |
| | Geotextile | m ² | 300 | 1,00 € | 300,00 € | 540 | 1,00 € | 540,00 € |
| TOTAL EURO SITE LB2 | | | | | 11.882,00 € | | | 20.363,20 € |

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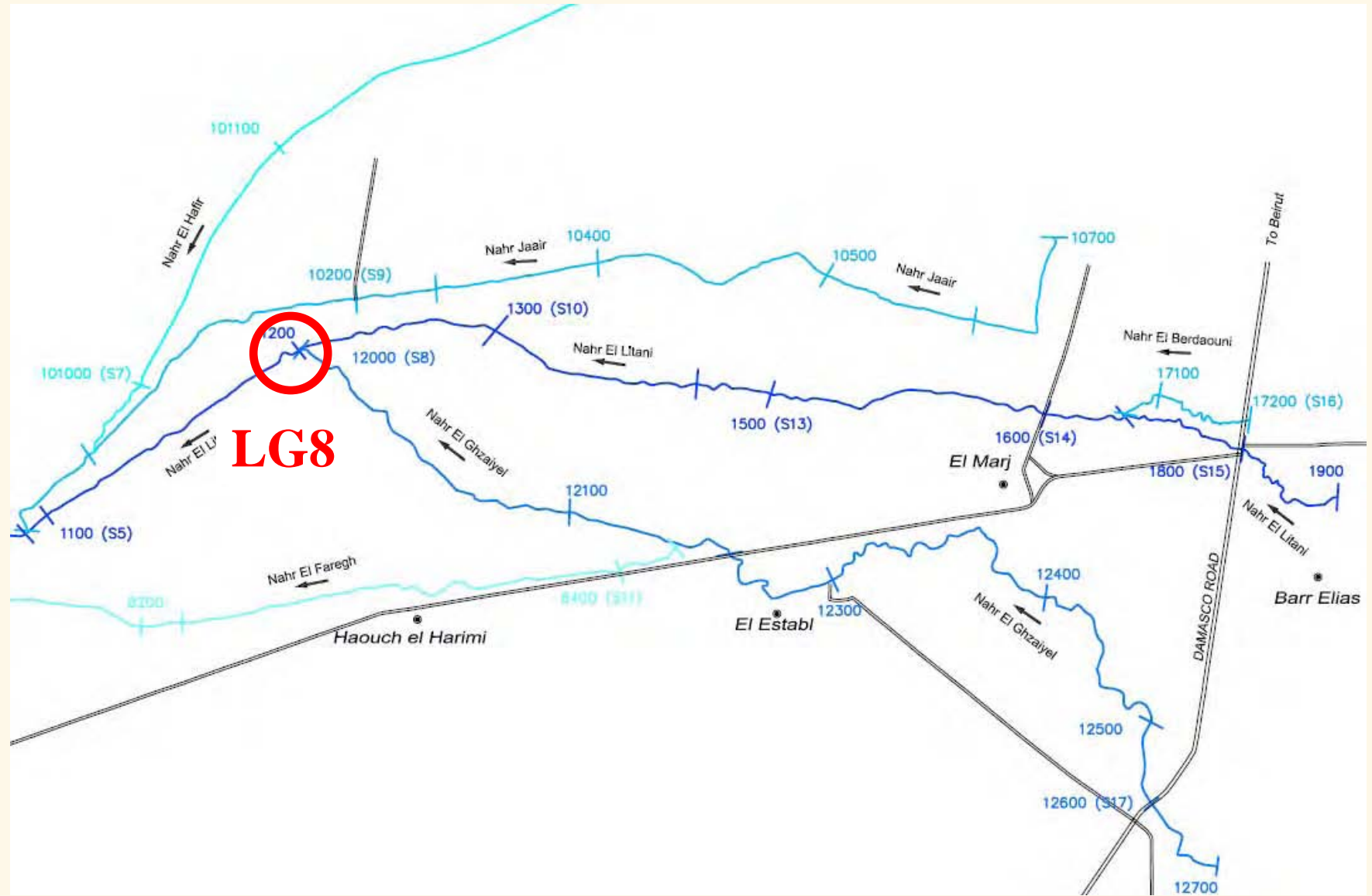
Final Report

LITANI-GHZAIYEL RIVERS

LG8 point

LOCALIZATION OF THE PLAN AREA

Reference Data: Litani River, Ghzaiyel River, LG8 POINT



EVALUATION OF THE JOBS

Reference Data:

Litani River, Ghzaiyel River, LG8 POINT


Photo



Explanation

The situations at the confluence of the Litani River and Ghzaiyel River before the jobs were characterized by some dams located in the river obstructing the flow.
The width of the section was variable and locally was too much low to permit the regular flow of the water in case of peak flows. There are the presence of a pump station in proximity of the river banks with problem of stability in case of evolution of the erosion.
This general situation causes several case of flooding with bad conditions for the agriculture.

EVALUATION OF THE JOBS

| | | |
|------------------------|---|--|
| Reference Data: | Litani River, Ghzaiyel River, LG8 POINT | |
| Photo |  | |
| Explanation | <p>The works executed on 2007 comprise:</p> <ul style="list-style-type: none"> - Gabions for 20 Lm - Total river re-calibration along Litani and Ghzaiyel river too for a total of 4.3 Km upstream and downstream of the confluence. Executed by the L.R.A. and partially with funds of the project | |

DURING THE WORKS

EVALUATION OF THE JOBS

Reference Data:

Litani River, Ghzaiyel River, LG8 POINT

Photo



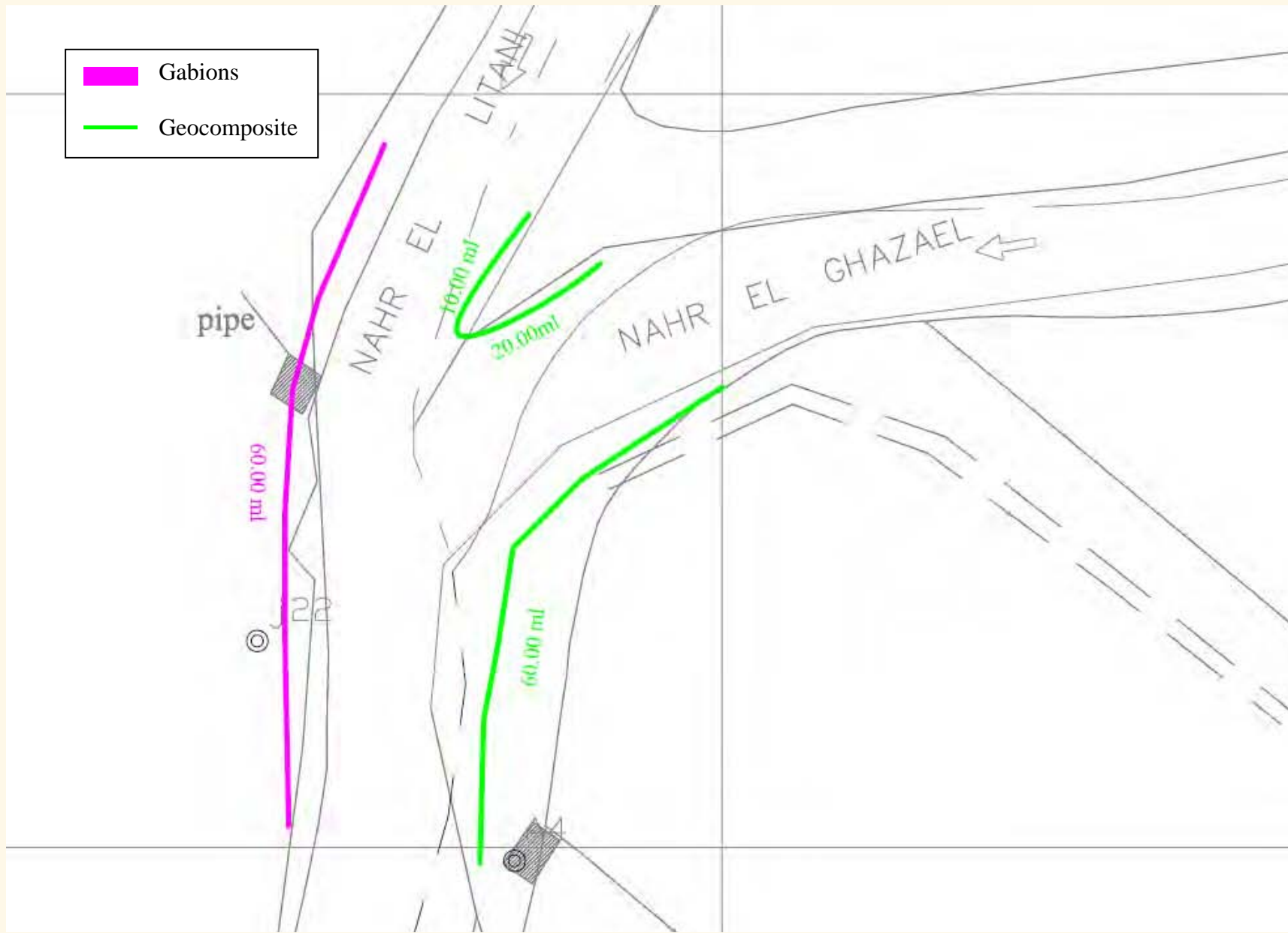
Explanation

The works have concurred to reach better conditions for the river flows. The recalibration of the river bed and banks have granted safer condition in case of flood. The new protections of the river banks near the pump station prevent the erosion and protect the building from flood.

AFTER THE WORKS

PROJECT PLAN

Reference Data: Litani River, Ghzaiyel River, LG8 POINT



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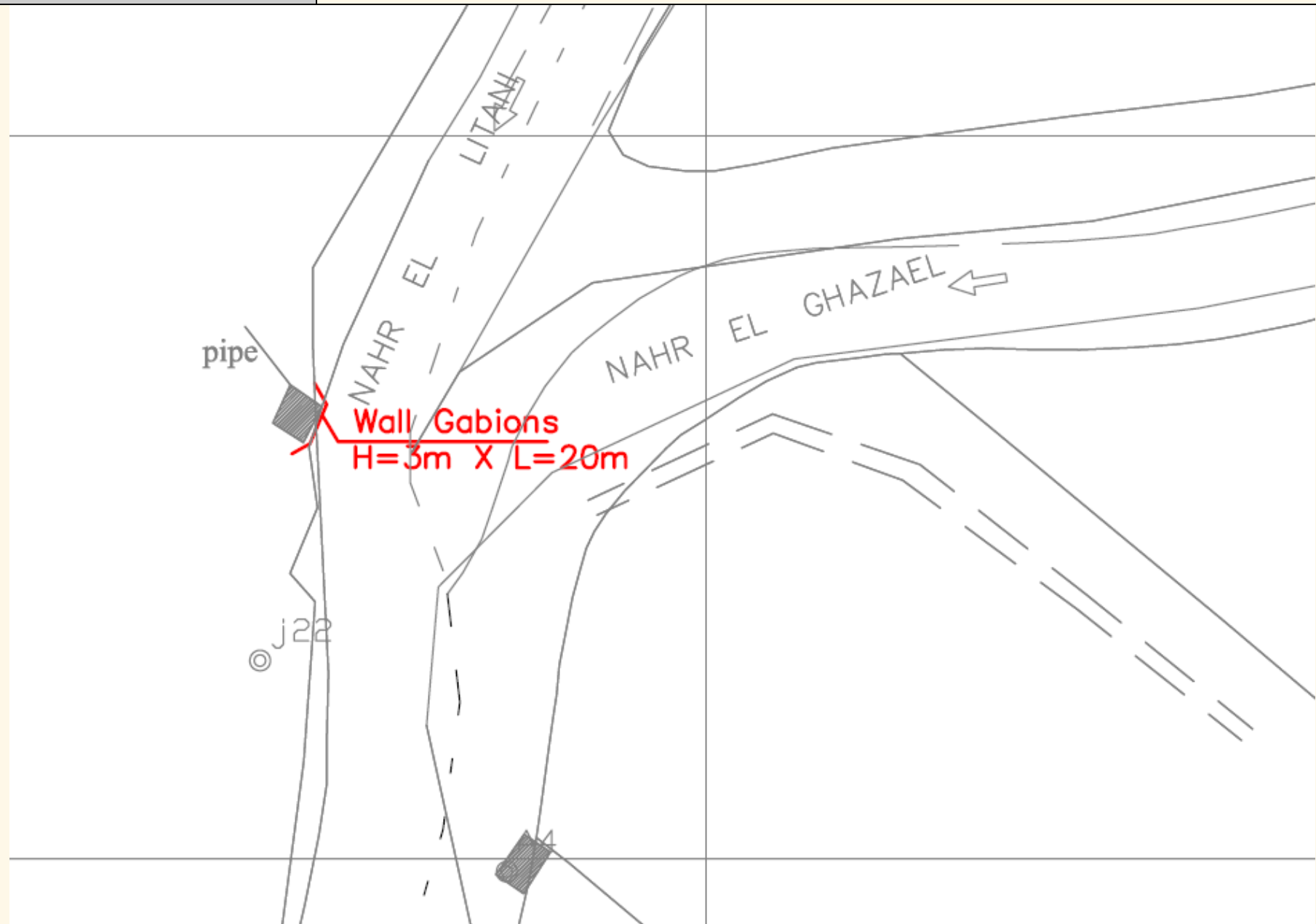
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AS - BUILT CONDITIONS

Reference Data:

Litani River, Ghzaiel River, LG8 POINT



FINAL ACCOUNTING

Reference Data: Litani River, Ghzaiyel River, LG8 POINT

| Site | Description | Quantities mentioned in the B.O.Q | | | | Quantities executed | | |
|-----------------------------|---|-----------------------------------|--------------|---------------|-------------|---------------------|--------------------|-------------------|
| | | Unit | Contract Qty | Unit. Price € | Total € | Qty. Executed | Unit. Price € | Total € Executed |
| LG 8 | Excavation and earth works | m ³ | 760 | 2,00 € | 1.520,00 € | 140 | 2,00 € | 280,00 € |
| | Gabbions | m ³ | 255 | 47,00 € | 11.985,00 € | 90 | 47,00 € | 4.230,00 € |
| | Mattresses | m ² | 180 | 19,00 € | 3.420,00 € | 60 | 19,00 € | 1.140,00 € |
| | Geocomposite | m ² | 930 | 12,80 € | 11.904,00 € | 0 | 12,80 € | 0,00 € |
| | Geotextile | m ² | 520 | 1,00 € | 520,00 € | 75 | 1,00 € | 75,00 € |
| | <u>Addendum to site L8</u> | | | | | | | |
| • | Rocks Laid as foundation under the Mattresses | m ³ | | | | 90 | 25,00 € | 2.250,00 € |
| • | Pump Usage | hr | | | | 0 | 0,00 € | 0,00 € |
| • | Drainage Box culverts | L.s | | | | 0 | 0,00 € | 0,00 € |
| TOTAL EURO SITE LG 8 | | | | | | | 29.349,00 € | 7.975,00 € |

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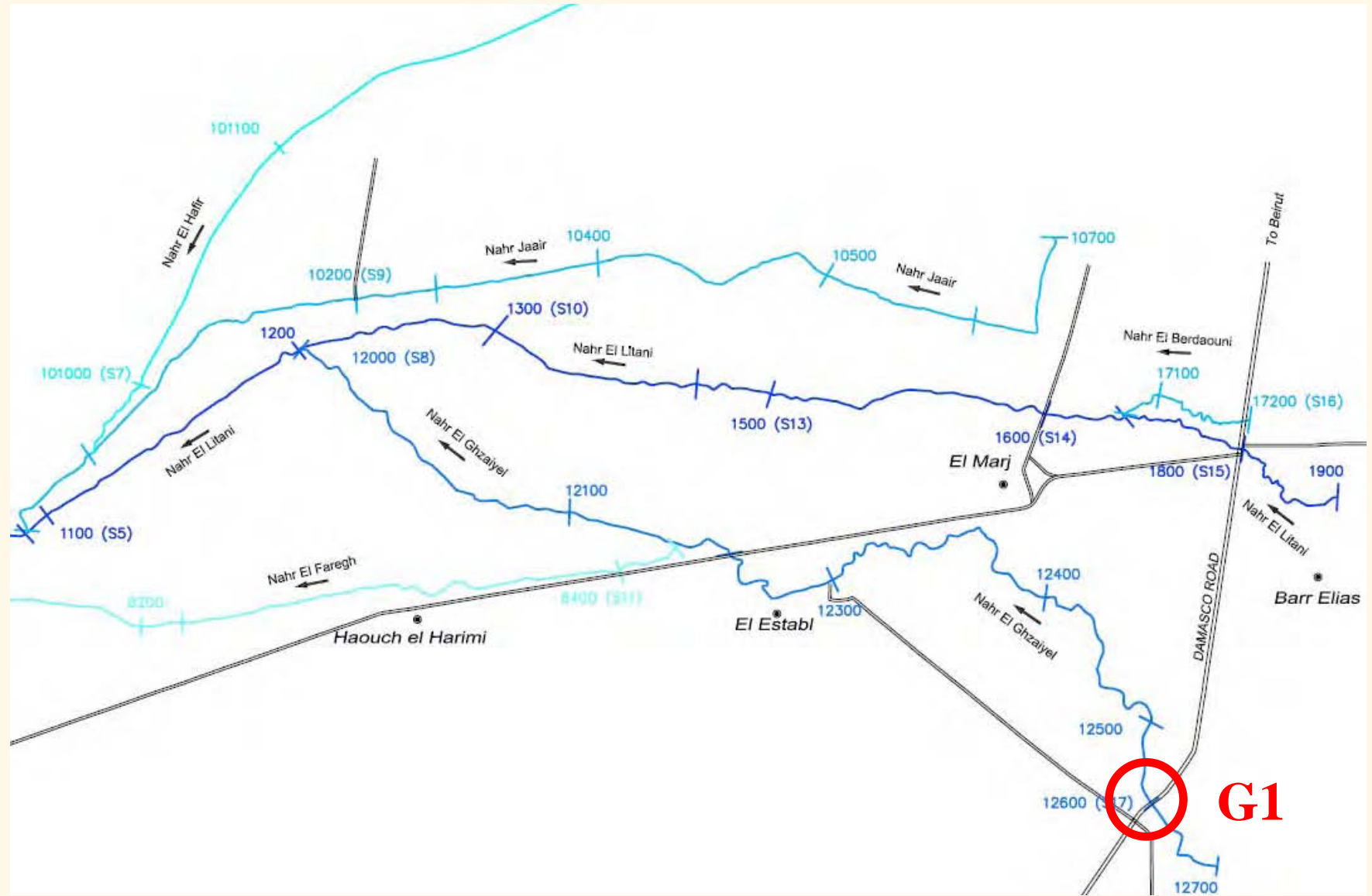
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LOCALIZATION OF THE PLAN AREA

Reference Data: Ghzaiyel River, Damascus Road, G1 POINT



EVALUATION OF THE JOBS

Reference Data:

Ghzaiyel River, Damascus Road, G1 POINT

Photo



Explanation

The situations of the Gzayel River before the jobs were characterized by river banks without protection and with heavy signs of erosion. The bed of the river in proximity of the bridge was tall due to the solid deposition and the uncontrolled discharge of garbage, This limits the flow that could pass through the bridge. The width of the section was variable and locally was too much low to permit the regular flow of the water in case of peak flows. This situation causes several case of flooding with bad conditions for the agriculture. Near the bridge we can found waste water pipe that without control discharge sewage into the river.

EVALUATION OF THE JOBS

Reference Data:

Ghzaiyel River, Damascus Road, G1 POINT

Photo



Explanation

During the works, according to the preliminary hydraulic evaluation we enlarge the width of the river to 18 m.
We model new river banks with appropriate inclination (1:3) compatibly with the new protections
We Execute 160 m. of gabions & geocomposite for every side of the river, cleaning the bed and recalibrating the banks for approximately 4 Km.
We extend the pipes and create a correct intersection with the river

DURING THE WORKS

EVALUATION OF THE JOBS

Reference Data:

Ghzaiyel River, Damascus Road, G1 POINT

Photo



Explanation

The works completed according to the project previsions have concurred to reach better conditions for the river flows.
 The recalibration of the river bed and banks have granted safer condition for the bridge.
 The new protections (gabions and geocomposite) of the river banks are more sustainable and permit a simple maintenance.
 Cultivated lands are safer from the flooding.

AFTER THE WORKS

PROJECT PLAN

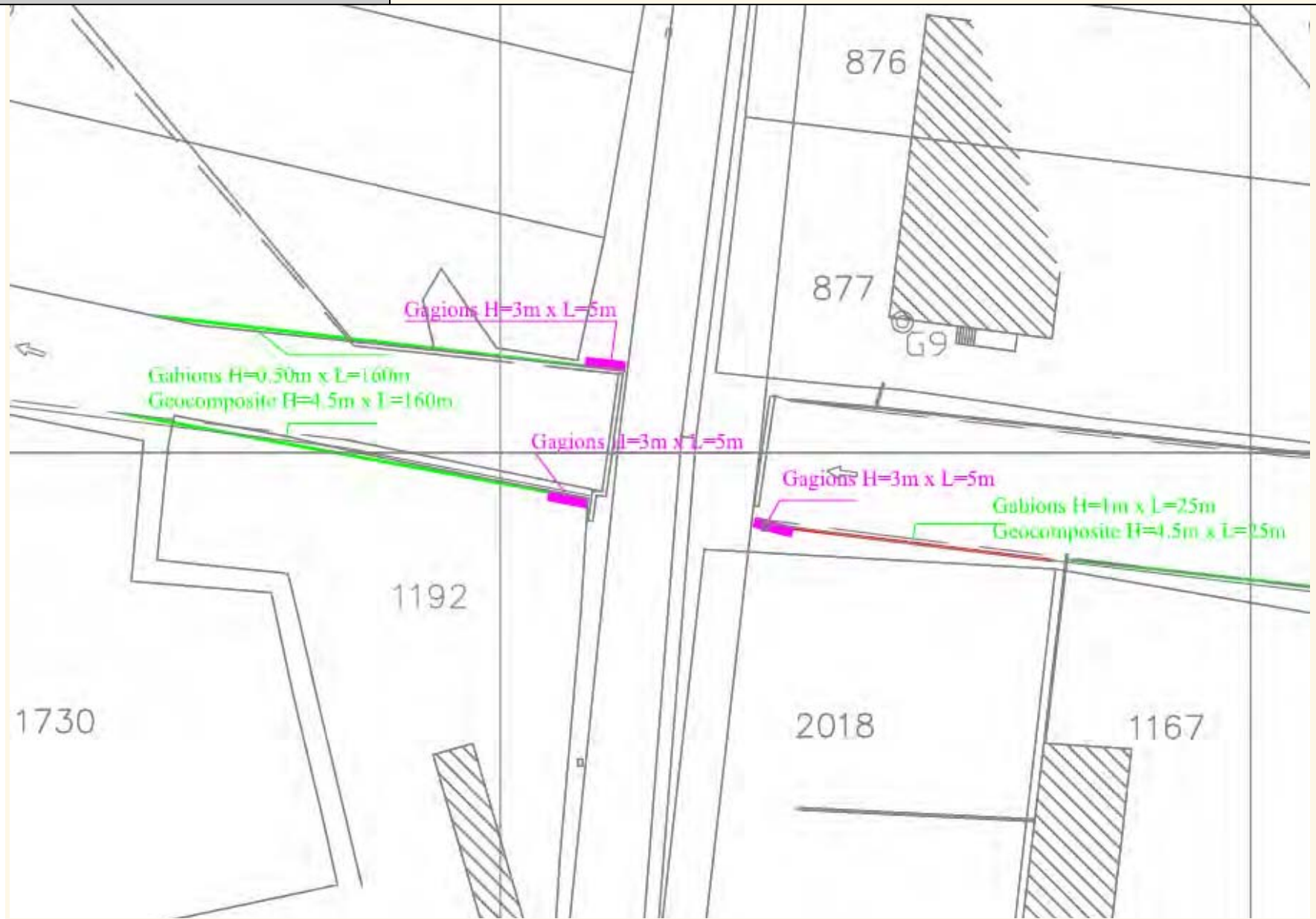
Reference Data: Ghzaiyel River, Damascus Road, G1 POINT



AS – BUILT CONDITIONS

Reference Data:

Ghzaiyel River, Damascus Road, G1 POINT



FINAL ACCOUNTING

Reference Data: Ghzaiyel River, Damascus Road, G1 POINT

| Site | Description | Qty. Mentioned in B.O.Q | | | | Qty. Executed | | |
|------|---|-------------------------|--------------|---------------|--------------------|---------------|---------------|--------------------|
| | | Unit | Contract Qty | Unit. Price € | Total € | Qty. Executed | Unit. Price € | Total € Executed |
| G1 | Excavation and earth works | m ³ | 1000 | 2,00 € | 2.000,00 € | 3180 | 2,00 € | 6.360,00 € |
| | Gabbions | m ³ | 127,5 | 53,00 € | 6.757,50 € | 244 | 53,00 € | 12.932,00 € |
| | Mattresses | m ² | 45 | 19,00 € | 855,00 € | 60 | 19,00 € | 1.140,00 € |
| | Geocomposite | m ² | 600 | 12,80 € | 7.680,00 € | 1861 | 12,80 € | 23.820,80 € |
| | Geotextile | m ² | 220 | 1,00 € | 220,00 € | 767 | 1,00 € | 767,00 € |
| | <u>Addendum to site G1</u> | | | | | | | |
| | • Rocks Laid as foundation under the Mattresses | m ³ | | | | 80 | 25,00 € | 2.000,00 € |
| | • Drainage Box culverts | L.s | | | | 2 | 1.000,00 € | 2.000,00 € |
| | • Pannel Board | L.s | | | | 1 | 350,00 € | 350,00 € |
| | TOTAL EURO SITE G1 | | | | 17.512,50 € | | | 49.369,80 € |

A.V.S.I. Associazione Volontari per il Servizio Internazionale

L.R.A. Litani River Authority

STUDIO ASSOCIATO Ingegneria Architettura Urbanistica - Morazzone (VA) Italy



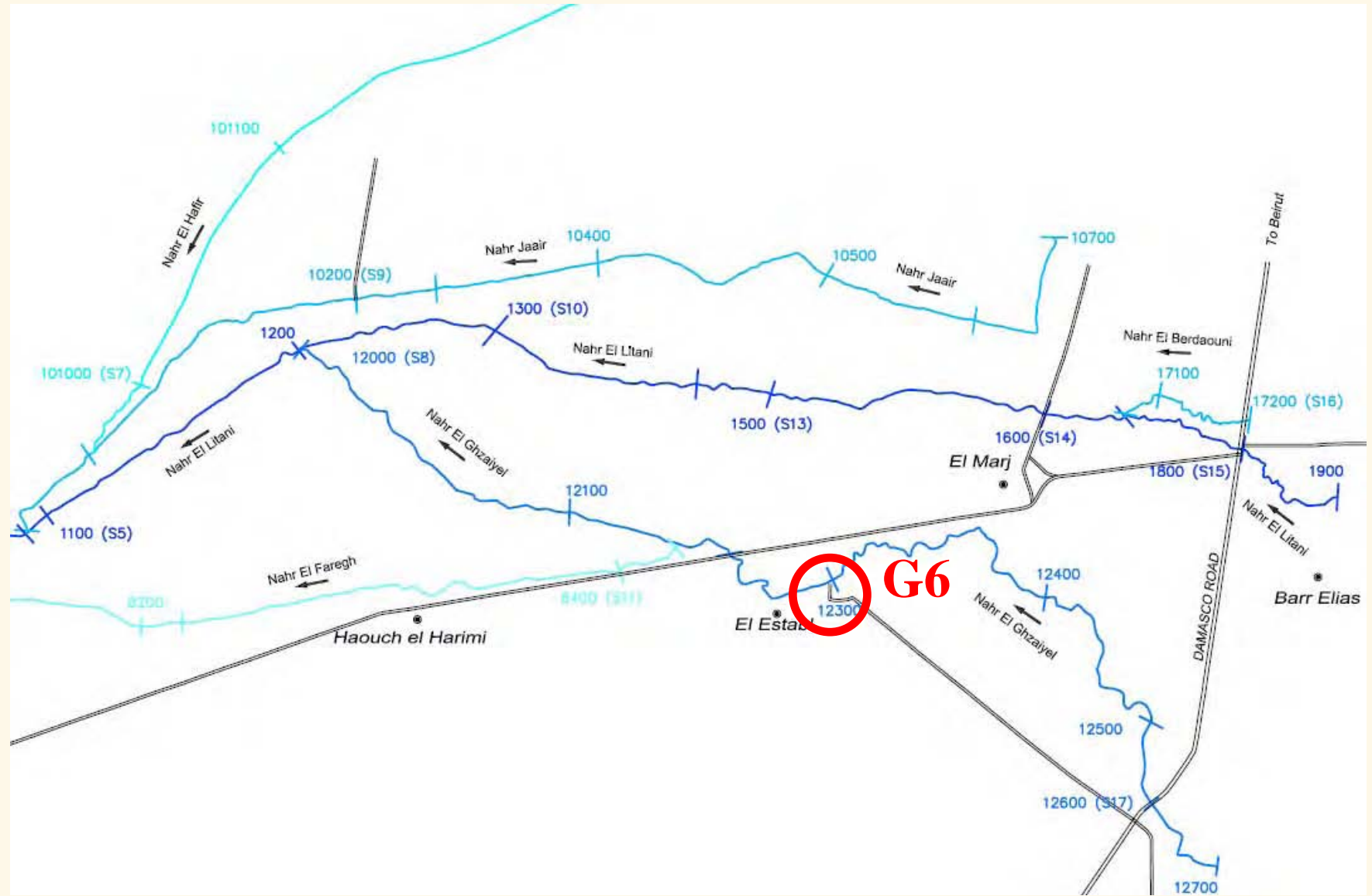
Final Report

GHZAIYEL RIVER

G6 point

LOCALIZATION OF THE PLAN AREA

Reference Data: Ghzaiyel River, G6 POINT



EVALUATION OF THE JOBS

Reference Data: Ghzaiyel River, G6 POINT

Photo



Explanation

The situations of the Gzayel River before the jobs were characterized by river banks without protection and with signs of erosion. The bed of the river in proximity of the bridge was tall due to the solid deposition. This limits the flow that could pass through the bridge. The width of the section was variable and locally was too much low to permit the regular flow of the water in case of peak flows. This situation causes several cases of flooding with bad conditions for the agriculture and the houses situated in proximity of the river.

BEFORE THE WORKS

EVALUATION OF THE JOBS

Reference Data:

Ghzaiyel River, G6 POINT

Photo



Explanation

During the works, according to the preliminary hydraulic evaluation we re-arrange the section of the river removing the solid deposition.
We model new river banks with appropriate inclination compatibly with the new protections
We reinforce the banks with mattresses and gabions on every side of the river, cleaning the bed and recalibrating the banks upstream and downstream the bridge.

DURING THE WORKS

EVALUATION OF THE JOBS

Reference Data:

Ghzaiyel River, G6 POINT

Photo



Explanation

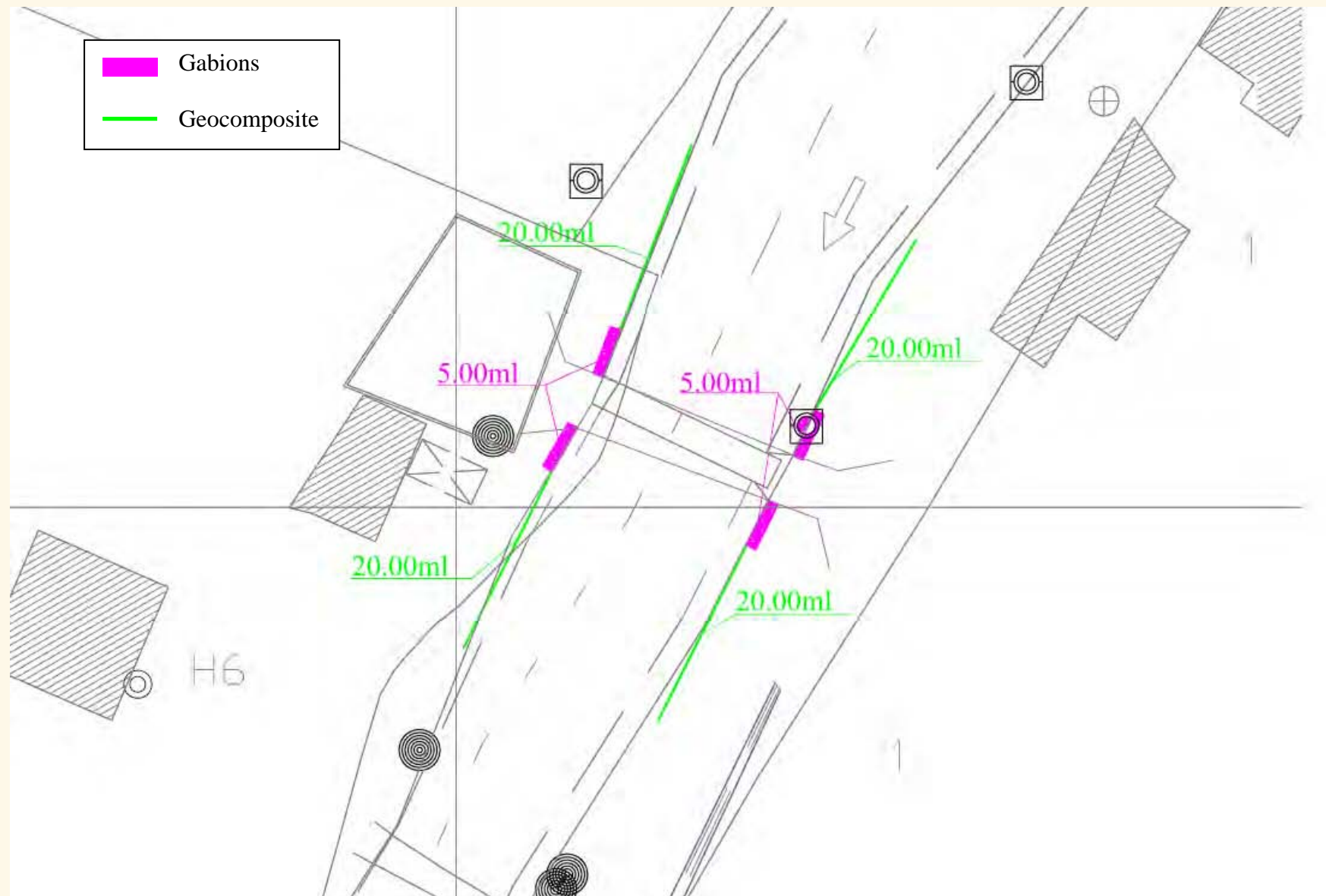
The works has been completed according to the project previsions and the hydraulic evaluation carried out with the support of the Litani River Authority. We had reached better conditions for the river flows. The recalibration of the river bed and banks have granted safer condition for the bridge.

The new protections (gabions and geocomposite)of the river banks are more sustainable and permit a simple maintenance. Cultivated lands and houses are more safer from the flooding

AFTER THE WORKS

PROJECT PLAN

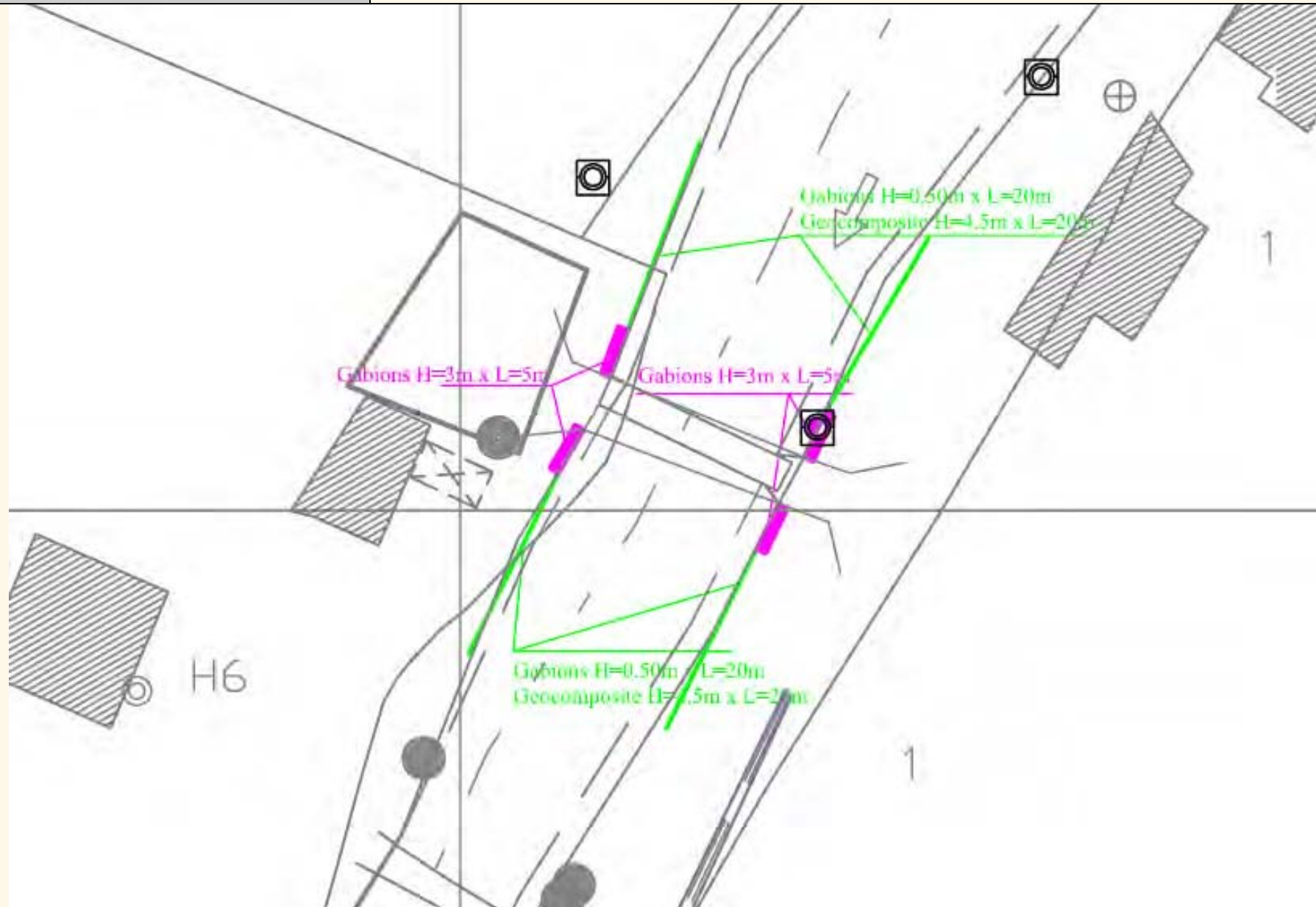
Reference Data: Ghzaiyel River, G6 POINT



AS - BUILT CONDITIONS

Reference Data:

Ghzaiyel River, G6 POINT



FINAL ACCOUNTING

Reference Data: Ghzaiel River, G6 POINT

| Site | Description | Quantities mentioned in the B.O.Q | | | | Quantities executed | | |
|--------------------------------|---|-----------------------------------|---------------|---------------|--------------------|---------------------|---------------|--------------------|
| | | Unit | Contract Qty. | Unit. Price € | Total € | Qty. Executed | Unit. Price € | Total € Executed |
| G 6/7/9 | Excavation and earth works | m ³ | 1650 | 2,00 € | 3.300,00 € | 3295 | 2,00 € | 6.590,00 € |
| | Gabbions | m ³ | 440 | 47,00 € | 20.680,00 € | 408,5 | 47,00 € | 19.199,50 € |
| | Mattresses | m ² | 300 | 19,00 € | 5.700,00 € | 380 | 19,00 € | 7.220,00 € |
| | Geocomposite | m ² | 960 | 12,80 € | 12.288,00 € | 880 | 12,80 € | 11.264,00 € |
| | Geotextile | m ² | 920 | 1,00 € | 920,00 € | 679 | 1,00 € | 679,00 € |
| | <u>Addendum to site G 6/7/9</u> | | | | | | | |
| • | Rocks Laid as foundation under the Mattresses | m ³ | | | | 288 | 25,00 € | 7.200,00 € |
| • | Drainage Box culverts | Ls | | | Force Mageur | 1 | 2.500,00 € | 2.500,00 € |
| • | Pannel Board | Ls | | | | 0 | 0,00 € | 0,00 € |
| | | | | | | | | |
| TOTAL EURO SITE G 6/7/9 | | | | | 42.888,00 € | | | 54.652,50 € |

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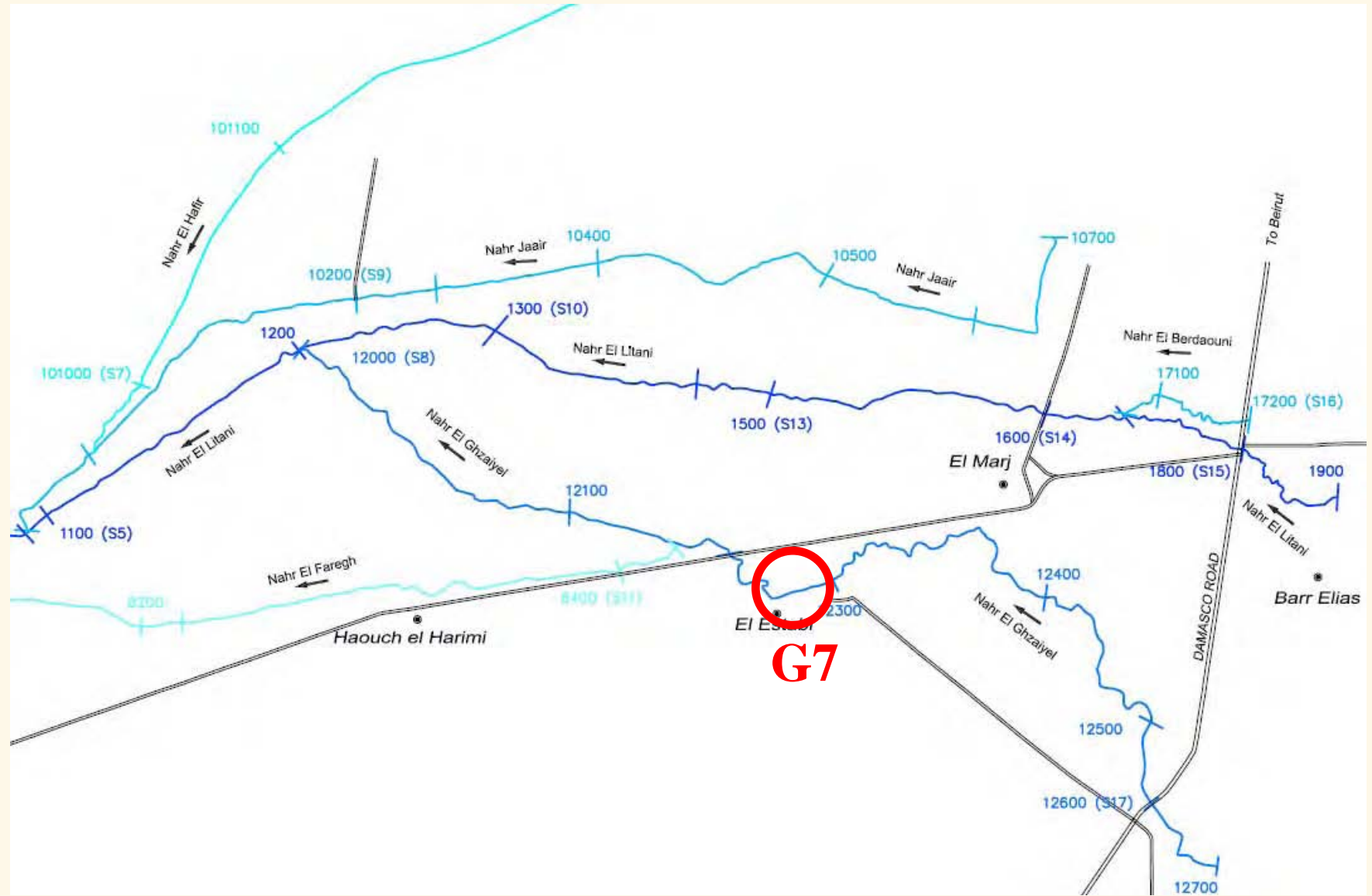
L.R.A. Litani River Authority

STUDIO ASSOCIATO Ingegneria Architettura Urbanistica - Morazzone (VA) Italy



LOCALIZATION OF THE PLAN AREA

Reference Data: Ghzaiyel River, G7 POINT



EVALUATION OF THE JOBS

Reference Data:

Ghzaiel River, G7 POINT

Photo



Explanation

The situations of the Gzayel River before the jobs were characterized by river banks without protection and with signs of erosion. The bed of the river in proximity of the bridge was tall due to the solid deposition and vegetation. This limits the flow that could pass through the bridge. The width of the section was variable and locally was too much low to permit the regular flow of the water in case of peak flows. This situation causes several cases of flooding with bad conditions for the agriculture and the houses situated in proximity of the river.

EVALUATION OF THE JOBS

Reference Data:

Ghzaiyel River, G7 POINT

Photo



Explanation

During the works, according to the preliminary hydraulic evaluation we re-arrange the section of the river removing the solid deposition. We model new river banks with appropriate inclination compatibly with the new protections. We reinforce the banks with mattresses and gabions on every side of the river, cleaning the bed and recalibrating the banks upstream and downstream the bridge.

DURING THE WORKS

EVALUATION OF THE JOBS

Reference Data:

Ghzaiyel River, G7 POINT

Photo



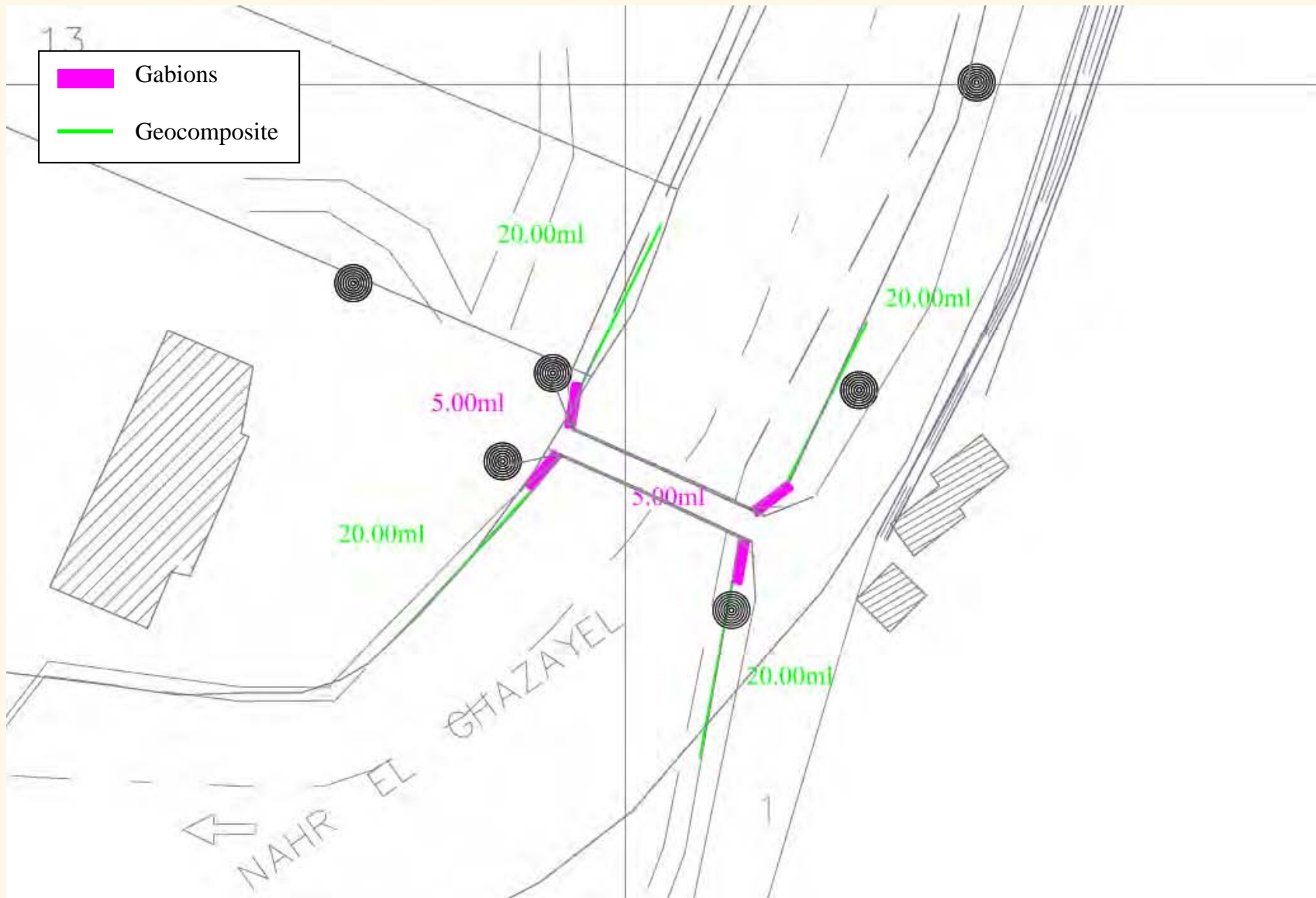
Explanation

The works has been completed according to the project previsions and the hydraulic evaluation carried out with the support of the Litani River Authority. We had reached better conditions for the river flows. The recalibration of the river bed and banks have granted safer condition for the bridge. The new protections (gabions and mattresses)of the river banks are more sustainable and permit a simple maintenance. Cultivated lands and houses are more safer from the flooding

AFTER THE WORKS

PROJECT PLAN

Reference Data: Ghzaiyel River, G7 POINT



AS - BUILT CONDITIONS

Reference Data: Ghzaiyel River, G7 POINT



FINAL ACCOUNTING

Reference Data: Ghzaiyel River, G7 POINT

| Site | Description | Quantities mentioned in the B.O.Q | | | | Quantities executed | | |
|--------------------------------|---|-----------------------------------|---------------|---------------|--------------------|---------------------|---------------|--------------------|
| | | Unit | Contract Qty. | Unit. Price € | Total € | Qty. Executed | Unit. Price € | Total € Executed |
| G 6/7/9 | Excavation and earth works | m ³ | 1650 | 2,00 € | 3.300,00 € | 3295 | 2,00 € | 6.590,00 € |
| | Gabbions | m ³ | 440 | 47,00 € | 20.680,00 € | 408,5 | 47,00 € | 19.199,50 € |
| | Mattresses | m ² | 300 | 19,00 € | 5.700,00 € | 380 | 19,00 € | 7.220,00 € |
| | Geocomposite | m ² | 960 | 12,80 € | 12.288,00 € | 880 | 12,80 € | 11.264,00 € |
| | Geotextile | m ² | 920 | 1,00 € | 920,00 € | 679 | 1,00 € | 679,00 € |
| | <u>Addendum to site G 6/7/9</u> | | | | | | | |
| • | Rocks Laid as foundation under the Mattresses | m ³ | | | | 288 | 25,00 € | 7.200,00 € |
| • | Drainage Box culverts | Ls | | | Force Mageur | 1 | 2.500,00 € | 2.500,00 € |
| • | Pannel Board | Ls | | | | 0 | 0,00 € | 0,00 € |
| | | | | | | | | |
| TOTAL EURO SITE G 6/7/9 | | | | | 42.888,00 € | | | 54.652,50 € |

A.V.S.I. Associazione Volontari per il Servizio Internazionale

L.R.A. Litani River Authority

STUDIO ASSOCIATO Ingegneria Architettura Urbanistica - Morazzone (VA) Italy



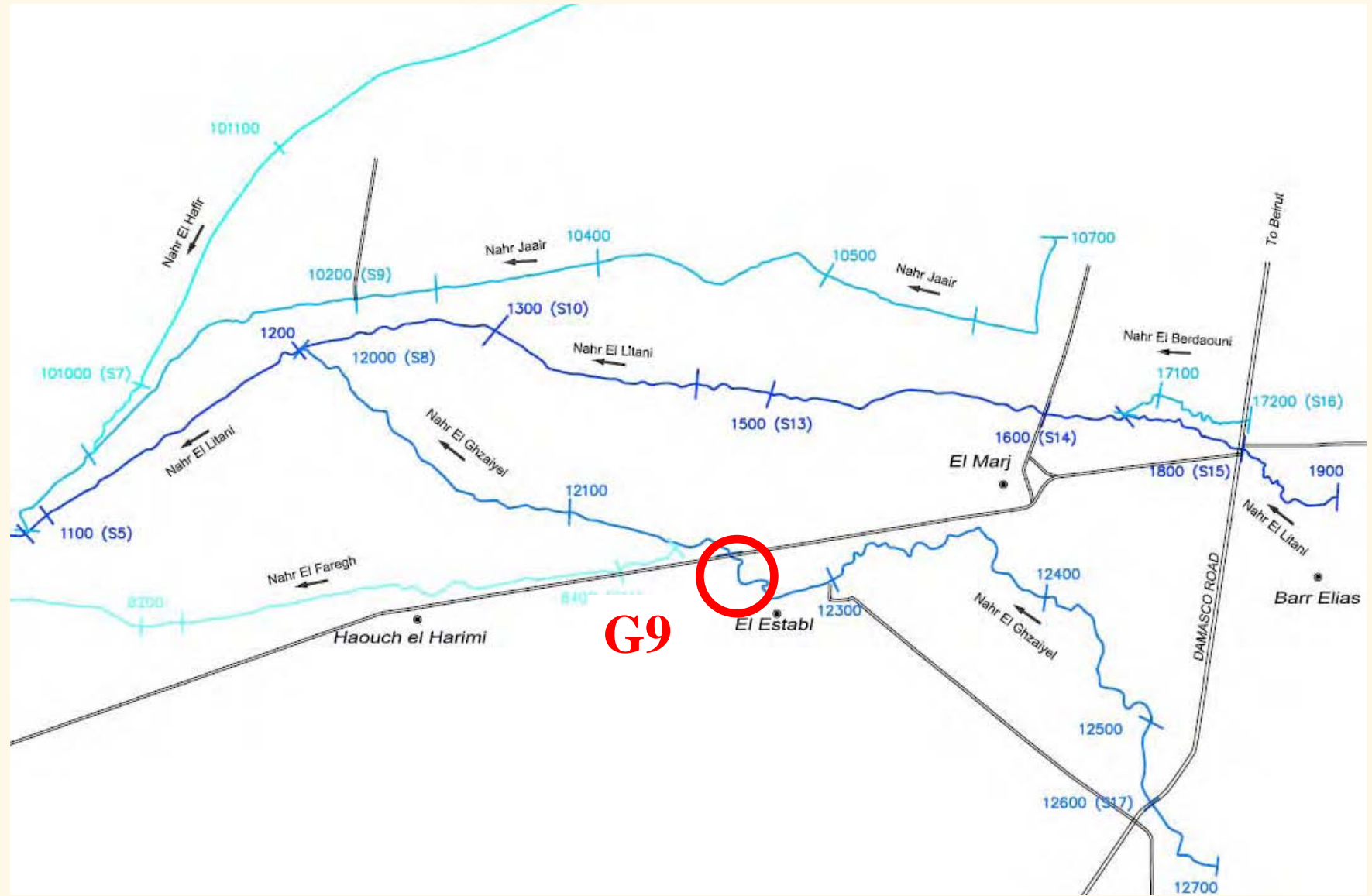
Final Report

GHZAIYEL RIVER

G9 point

LOCALIZATION OF THE PLAN AREA

Reference Data: Ghzaiyel River, G9 POINT



EVALUATION OF THE JOBS

Reference Data: Ghzaiel River, G9 POINT

Photo



Explanation

The situations of the Gzayel River before the jobs were characterized by river banks without protection and with erosion. The bed of the river in proximity of the bridge was tall due to the solid deposition. This limits the flow that could pass through the bridge. The width of the section was variable and locally was too much low to permit the regular flow of the water in case of peak flows. This situation causes several cases of flooding with bad conditions for the agriculture and the houses situated in proximity of the river.

BEFORE THE WORKS

EVALUATION OF THE JOBS

Reference Data:

Ghzaiyel River, G9 POINT

Photo



Explanation

During the works, according to the preliminary hydraulic evaluation we re-arrange the section of the river removing the solid deposition. We model new river banks with appropriate inclination compatibly with the new protections. We reinforce the banks with mattresses and of gabions on every side of the river, cleaning the bed and recalibrating the banks upstream and downstream the bridge.

DURING THE WORKS

EVALUATION OF THE JOBS

Reference Data: Ghzaiyel River, G9 POINT

Photo



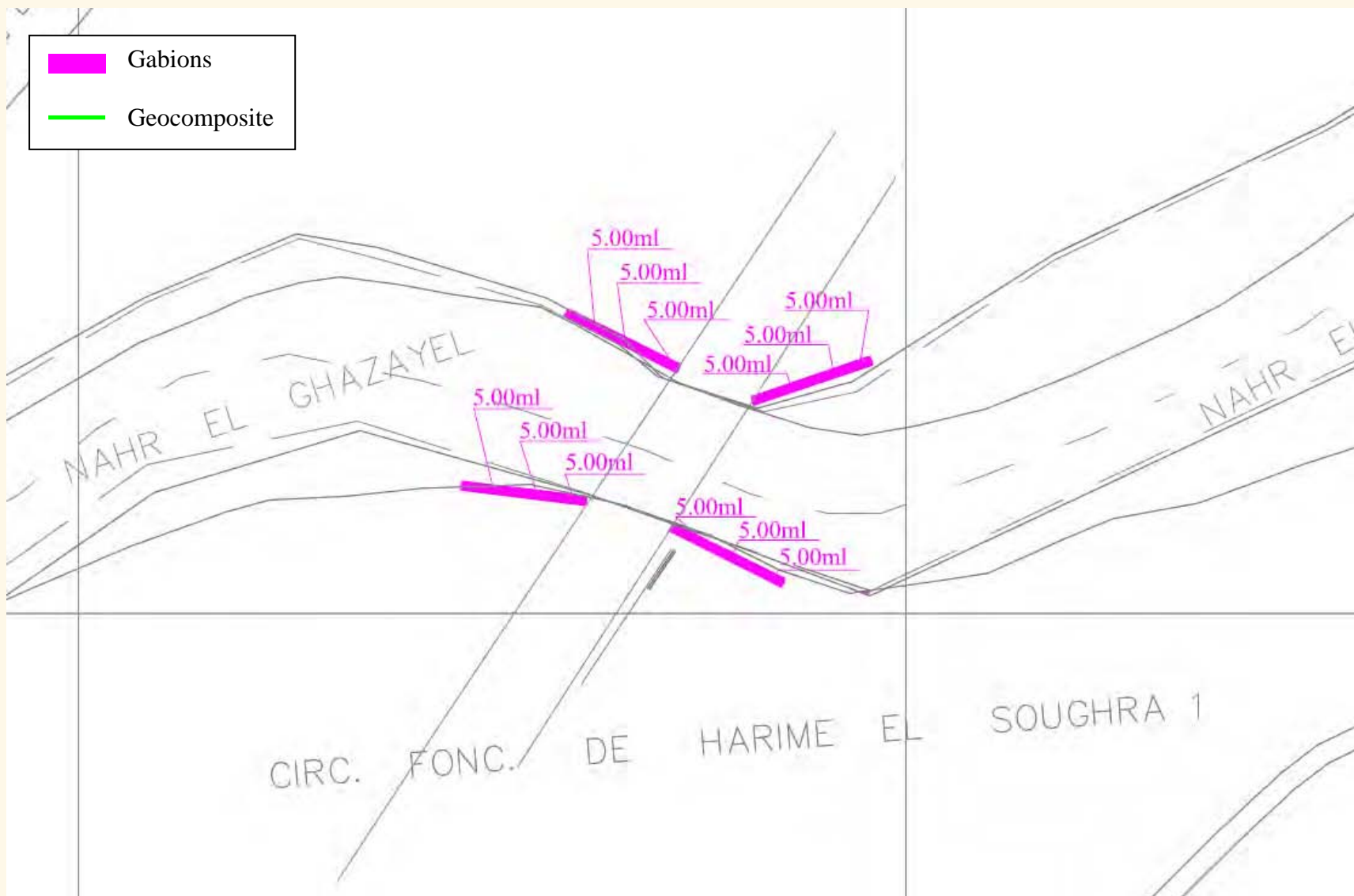
Explanation

The works has been completed according to the project previsions and the hydraulic evaluation carried out with the support of the Litani River Authority. We had reached better conditions for the river flows. The recalibration of the river bed and banks have granted safer condition for the bridge. The new protections (gabions and mattresses)of the river banks are more sustainable and permit a simple maintenance. Cultivated lands and houses are more safer from the flooding

AFTER THE WORKS

PROJECT PLAN

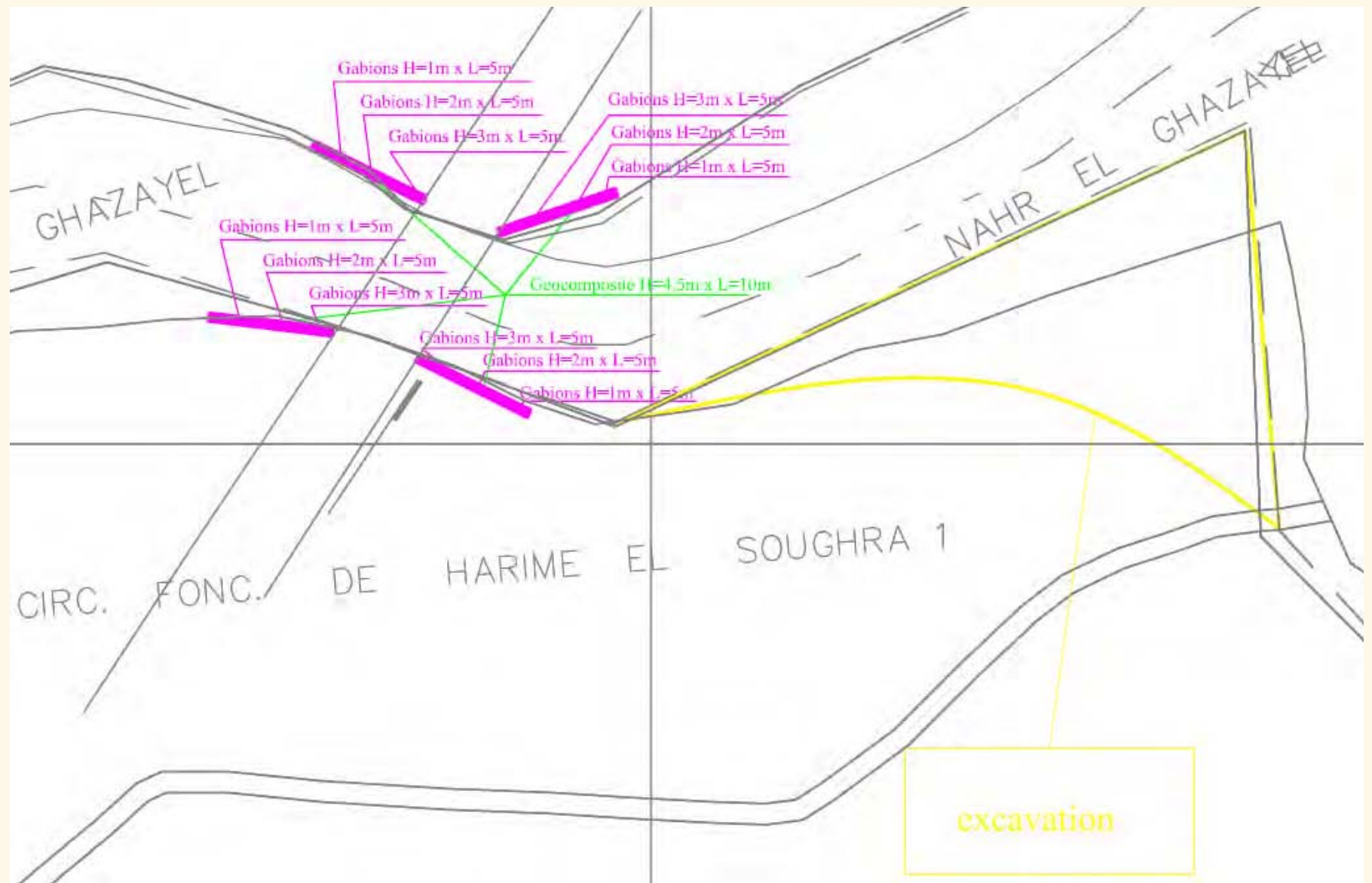
Reference Data: Ghzaiyel River, G9 POINT



AS - BUILT CONDITIONS

Reference Data:

Ghzaiyel River, G9 POINT



FINAL ACCOUNTING

Reference Data: Ghzaiel River, G9 POINT

| Site | Description | Quantities mentioned in the B.O.Q | | | | Quantities executed | | |
|--------------------------------|---|-----------------------------------|---------------|---------------|--------------------|---------------------|---------------|--------------------|
| | | Unit | Contract Qty. | Unit. Price € | Total € | Qty. Executed | Unit. Price € | Total € Executed |
| G 6/7/9 | Excavation and earth works | m ³ | 1650 | 2,00 € | 3.300,00 € | 3295 | 2,00 € | 6.590,00 € |
| | Gabbions | m ³ | 440 | 47,00 € | 20.680,00 € | 408,5 | 47,00 € | 19.199,50 € |
| | Mattresses | m ² | 300 | 19,00 € | 5.700,00 € | 380 | 19,00 € | 7.220,00 € |
| | Geocomposite | m ² | 960 | 12,80 € | 12.288,00 € | 880 | 12,80 € | 11.264,00 € |
| | Geotextile | m ² | 920 | 1,00 € | 920,00 € | 679 | 1,00 € | 679,00 € |
| | <u>Addendum to site G 6/7/9</u> | | | | | | | |
| • | Rocks Laid as foundation under the Mattresses | m ³ | | | | 288 | 25,00 € | 7.200,00 € |
| • | Drainage Box culverts | Ls | | | Force Mageur | 1 | 2.500,00 € | 2.500,00 € |
| • | Pannel Board | Ls | | | | 0 | 0,00 € | 0,00 € |
| | | | | | | | | |
| TOTAL EURO SITE G 6/7/9 | | | | | 42.888,00 € | | | 54.652,50 € |

A.V.S.I. Associazione Volontari per il Servizio Internazionale

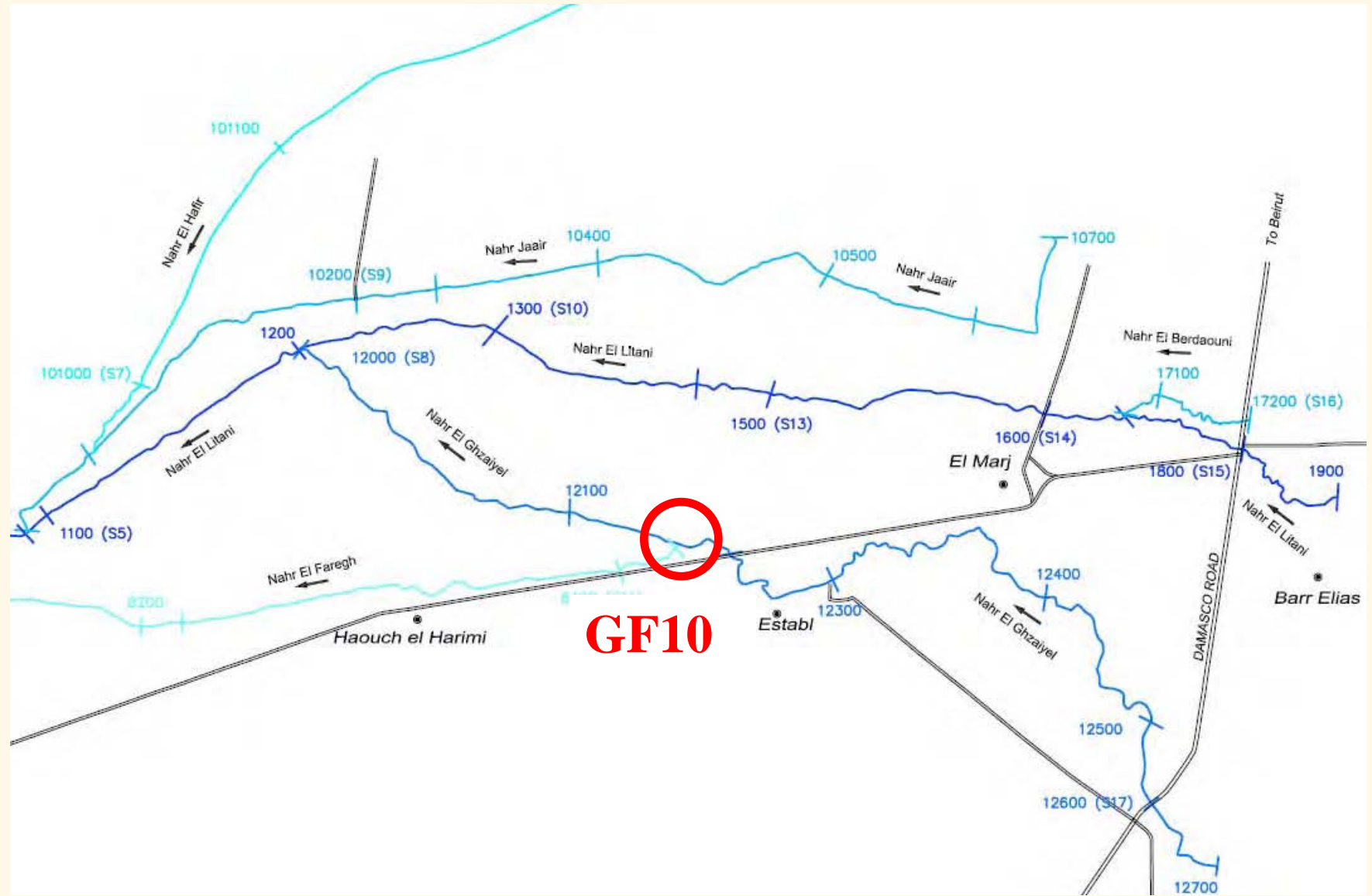
L.R.A. Litani River Authority

STUDIO ASSOCIATO Ingegneria Architettura Urbanistica - Morazzone (VA) Italy



LOCALIZATION OF THE PLAN AREA

Reference Data: Ghzaiyel River, Faregh River, GF10 POINT



EVALUATION OF THE JOBS

Reference Data:

Ghzaiyel River, Faregh River, GF10 POINT

Photo



Explanation

The situations of the Gzayel River at the confluence with El Faregh river before the jobs were characterized by a wide river section without banks protection and with the presence of a pump station on the left side upstream of the confluence.
The bed of the river in proximity of the confluence was characterized by solid deposition and uncontrolled growth of the vegetation.
The width of the section was variable and needs a regulation to give a right direction at the flow.

EVALUATION OF THE JOBS

Reference Data:

Ghzaiyel River, Faregh River, GF10 POINT

Photo




Explanation

The works were characterized by two integrated participations, the Litani River Authority provide an extended recalibration of the river section along 2 Km and we have done a localized protection of the left river banks near the pump station

DURING THE WORKS

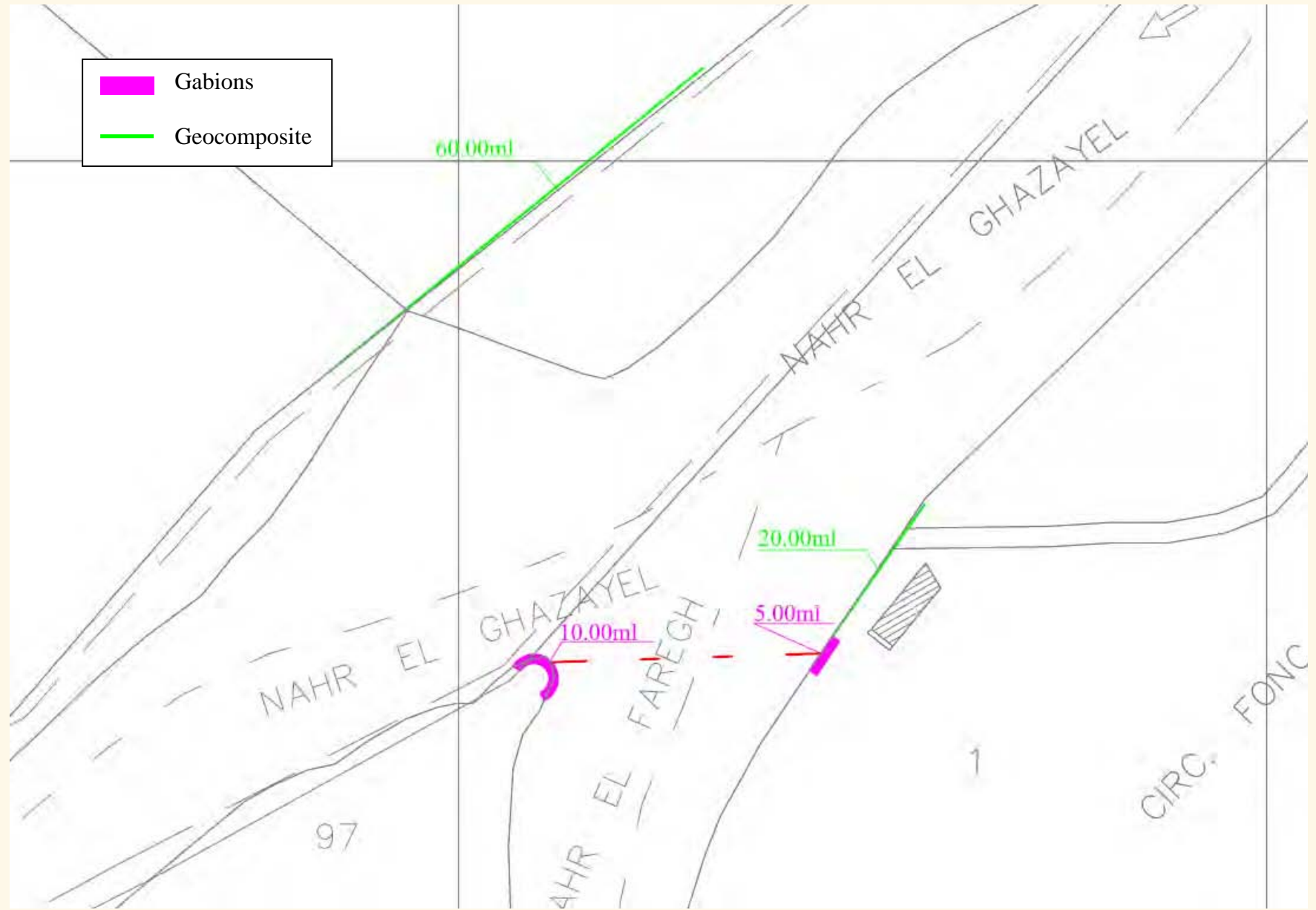
EVALUATION OF THE JOBS

| | | |
|------------------------|--|--|
| Reference Data: | Ghzaiyel River, Faregh River, GF10 POINT | |
| Photo |  | |
| Explanation | <p>After the works we have guaranteed a better flow to the water current protecting the banks more vulnerable (pump station) from the erosion.</p> | |

AFTER THE WORKS

PROJECT PLAN

Reference Data: Ghzaiyel River, Faregh River, GF10 POINT



AS - BUILT CONDITIONS

Reference Data:

Ghzaiyel River, Faregh River, GF10 POINT



FINAL ACCOUNTING

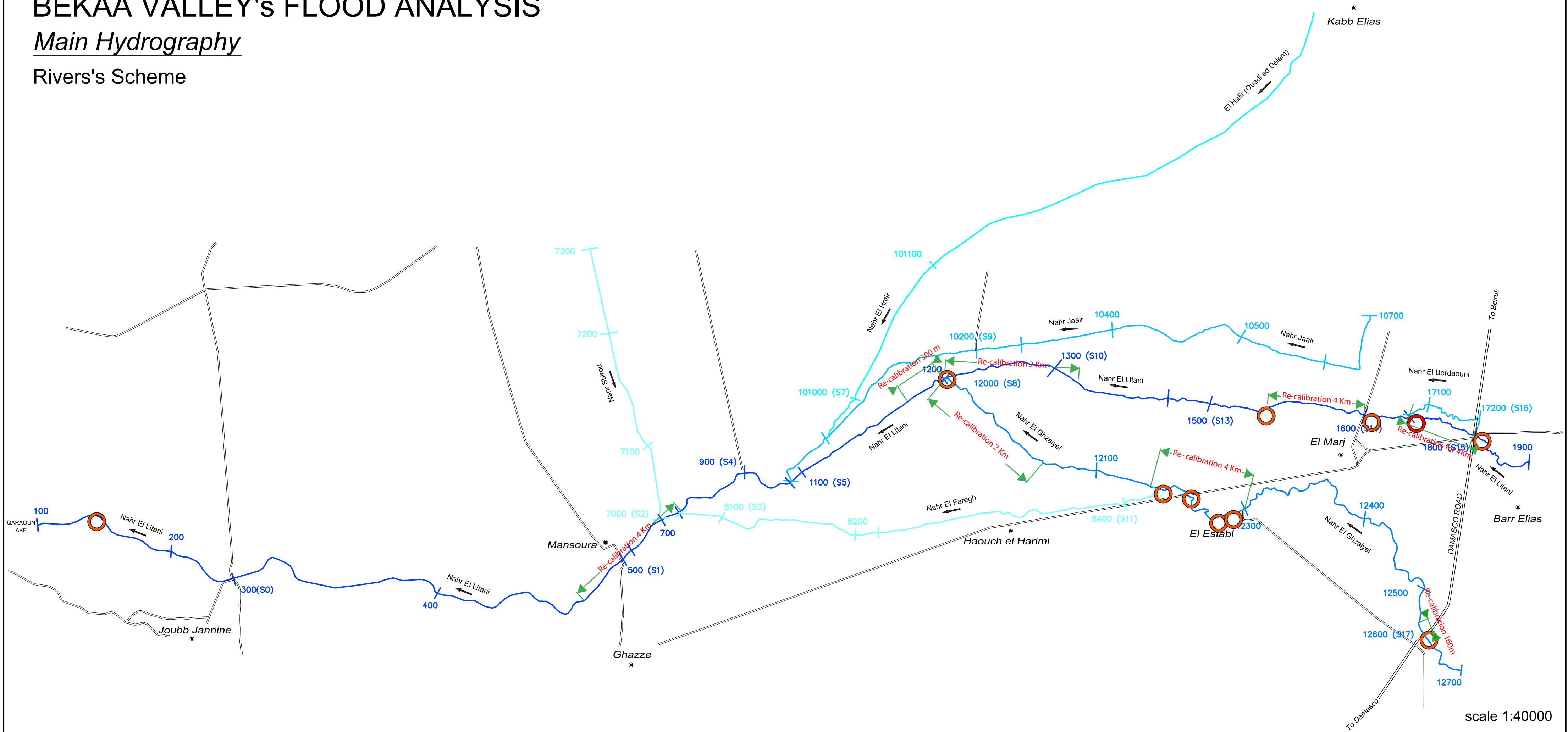
Reference Data: Ghzaiel River, Faregh River, GF10 POINT

| Site | Description | Quantities mentioned in the B.O.Q | | | | Quantities executed | | |
|------------------------------|---|-----------------------------------|--------------|---------------|--------------------|---------------------|---------------|-------------------|
| | | Unit | Contract Qty | Unit. Price € | Total € | Qty. Executed | Unit. Price € | Total € Executed |
| GF 10 | Excavation and earth works | m ³ | 350 | 2,00 € | 700,00 € | 195 | 2,00 € | 390,00 € |
| | Gabbions | m ³ | 157,5 | 53,00 € | 8.347,50 € | 68,5 | 53,00 € | 3.630,50 € |
| | Mattresses | m ² | 85 | 19,00 € | 1.615,00 € | 96 | 19,00 € | 1.824,00 € |
| | Geocomposite | m ² | 360 | 12,80 € | 4.608,00 € | 0 | 12,80 € | 0,00 € |
| | Geotextile | m ² | 360 | 1,00 € | 360,00 € | 114 | 1,00 € | 114,00 € |
| | <u>Addendum to site G10</u> | | | | | | | |
| • | Rocks Laid as foundation under the Mattresses | m ³ | | | | 0 | 0,00 € | 0,00 € |
| • | Drainage Box culverts | L.s | | | | 0 | 0,00 € | 0,00 € |
| • | Flood Gate | L.s | 1 | 600,00 € | 600 | 0 | 0,00 € | 0,00 € |
| TOTAL EURO SITE GF 10 | | | | | 16.230,50 € | | | 5.958,50 € |

BEKAA VALLEY'S FLOOD ANALYSIS

Main Hydrography

Rivers's Scheme



scale 1:40000

River machinaries purchased by the project





River cleaning using the machines provided by IrWa



**Comparision between the state of some of the critical points before and after
IrWa's intervention**

L1 Litani Damascus road - before



L1 Litani Damascus road - after



G1 – Ghzayel Damascus road - Before



G1 – Ghzayel Damascus road - After



L 3 Litani Marj - before



L 3 Litani Marj - after



Intervention techniques

Gabbions



Mattresses



Geocomposite

