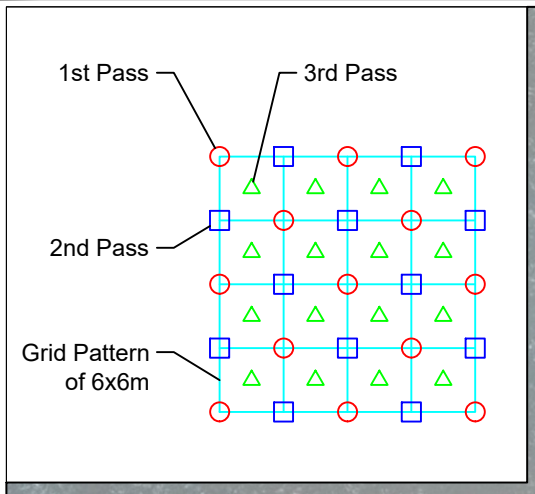


Allowable Elevation: +25.00m asl

Allowable Elevation: +10.00m asl

X -339600

X -339400

X -339200

Runway Centerline

Runway Western Limit

Expro Limit

WWTP Area Within Setback of 150m From Runway Centerline:15,110m²

Zone Within Setback of 150m From Runway Centerline

Ground-Vibration-Minimizing Trench (3m deep, 0.6m wide)

Area that will be Treated by Deep Dynamic Compaction

Grid Pattern of 6x6m

Area Phase 2
46,339.99m²

Landfill Cell 2B

Area Phase 1b
33,351.58m²m²

Landfill Cell 2A

Area Phase 1a
24,559.40m²

Landfill Cell 1

BH4/Ghadir - 2024
X -339529.27
Y -35899.5

BH3/Ghadir - 2024
X -339557.45
Y -36025.26

BH2/Ghadir - 2024
X -339516.43
Y -36185.07

BH1/Ghadir - 2024
X -339492.53
Y -36374.53

Y -35600

Y -35800

Y -36000

Y -36200

Y -36400

C

C

B

B

A

A

N

No	DATE	REVISIONS	ARCH	CIVIL	MECH	ELEC

LEBANESE REPUBLIC
COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

Soil Treatment For The "Expansion And Upgrade Of Al-ghadir Wastewater Treatment Plant Project"

DAR AL HANDASAH NAZIH TALEB & PARTNERS Founded 1956

ARTELIA

Deep Dynamic Compaction

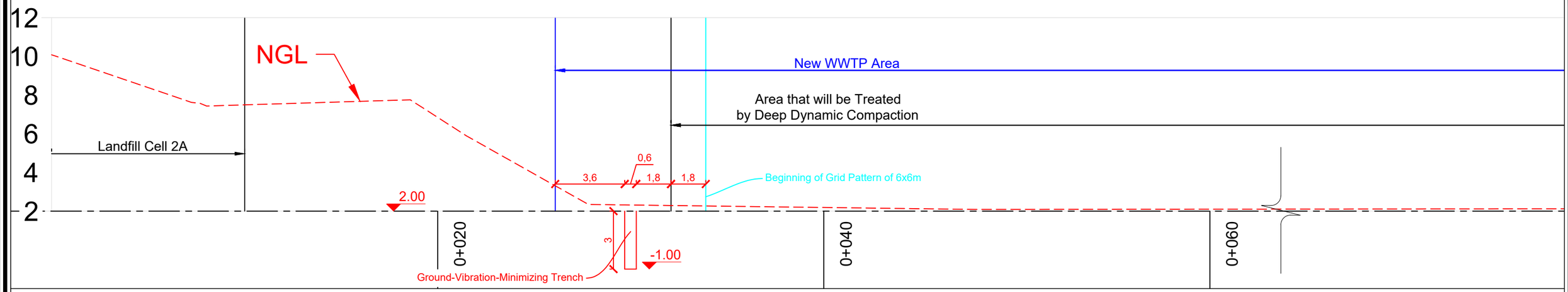
Plan View

DRAWN :	–DRN–
CHECKED :	–CHK–
APPROVED :	–APP–
DATE :	07 October 2024
SCALE :	N.T.S
FILE NAME	DDC–PV–01

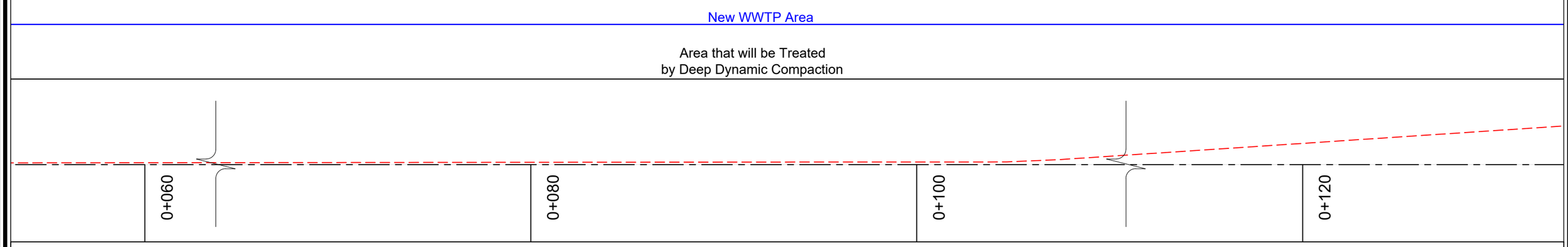
PROJECT	DIVISION	SUB–DIVISION	SHEET	REVISION
L2401DS	DDC	PV	01	–REV–

A3 Size

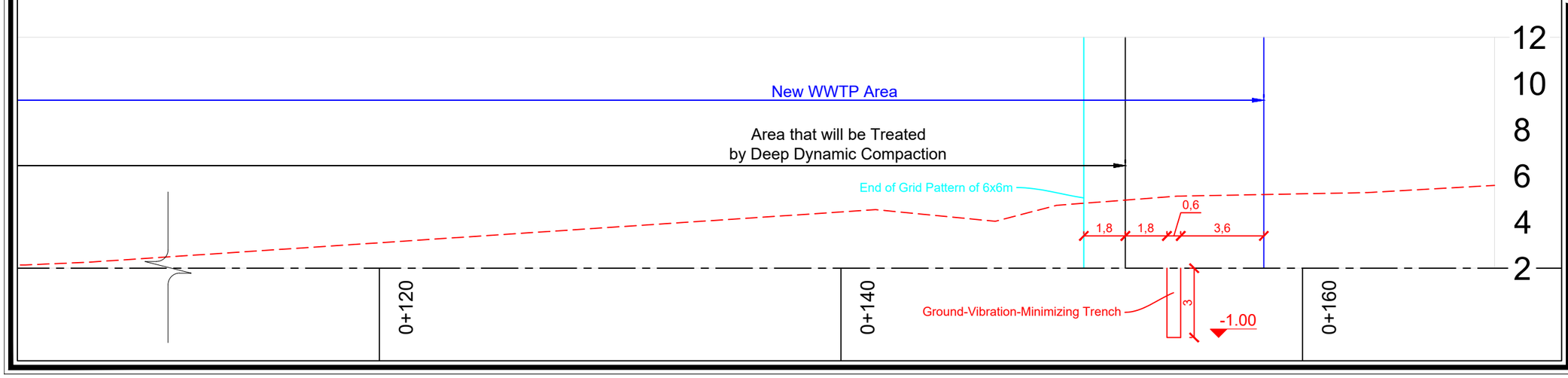
Section A



Section A



Section A



No	DATE	REVISIONS	ARCH	CIVIL	MECH	ELEC

LEBANESE REPUBLIC
COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

Soil Treatment For The "Expansion And Upgrade Of Al-ghadir Wastewater Treatment Plant Project"

DAR AL HANDASAH
NAZIH TALEB & PARTNERS
Founded 1956

ARTELIA

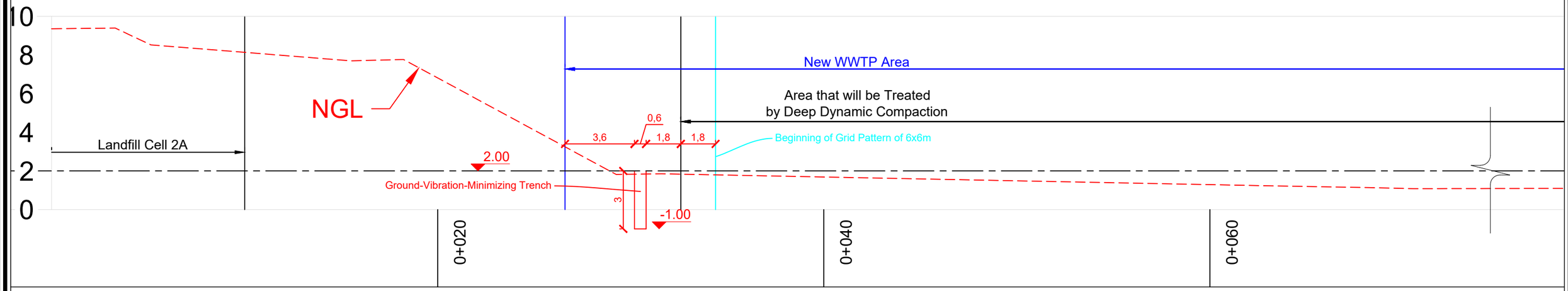
Deep Dynamic Compaction

Section A-A

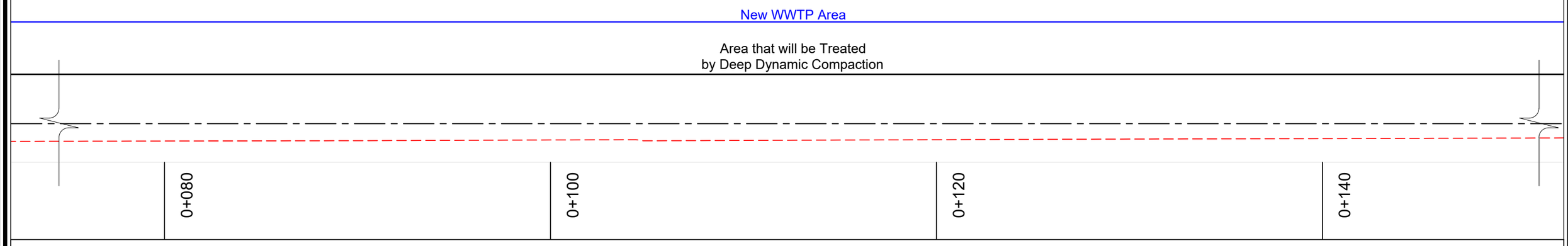
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PROJECT	DIVISION	SUB–DIVISION	SHEET	REVISION
L2401DS	DDC	S	02	–REV–

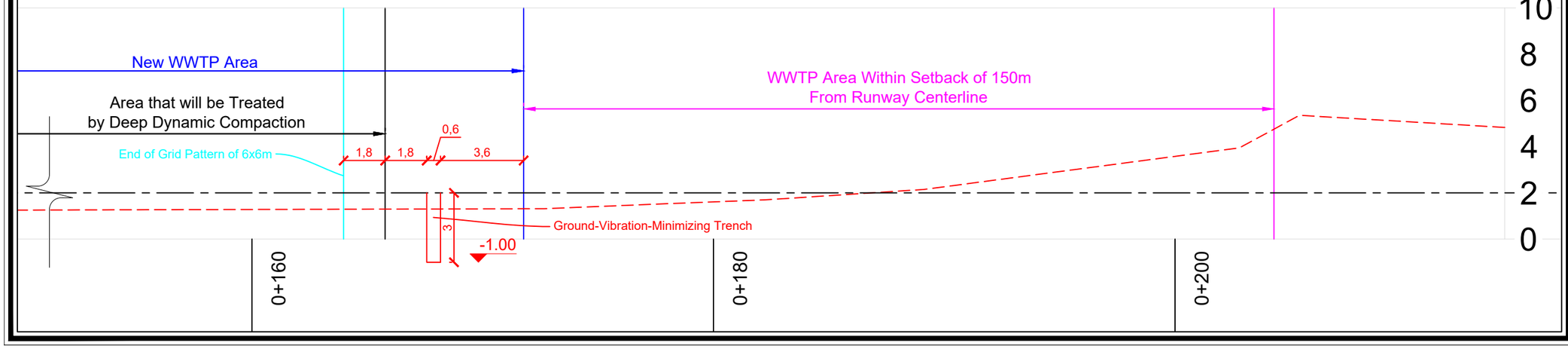
Section B



Section B



Section B



No	DATE	REVISIONS	ARCH	CIVIL	MECH	ELEC

LEBANESE REPUBLIC
COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

Soil Treatment For The "Expansion And Upgrade Of Al-ghadir Wastewater Treatment Plant Project"

DAR AL HANDASAH
NAZIH TALEB & PARTNERS
Founded 1956

ARTELIA

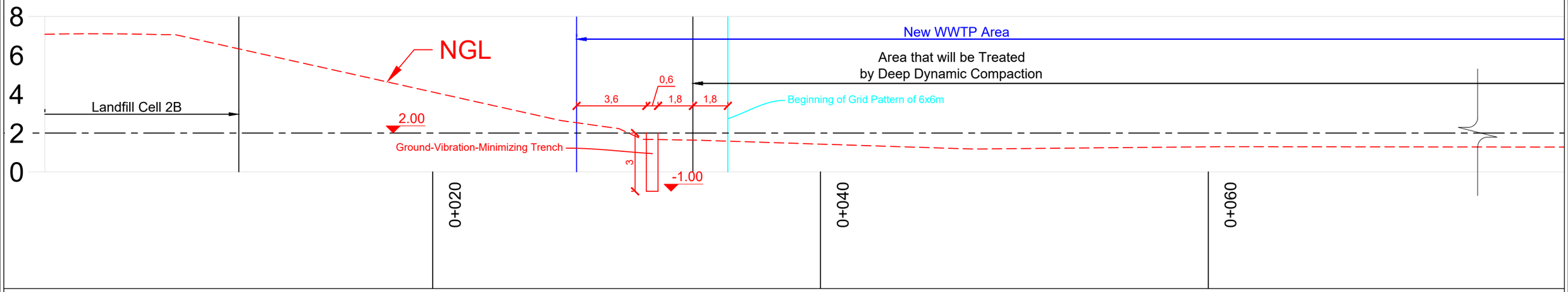
Deep Dynamic Compaction

Section B-B

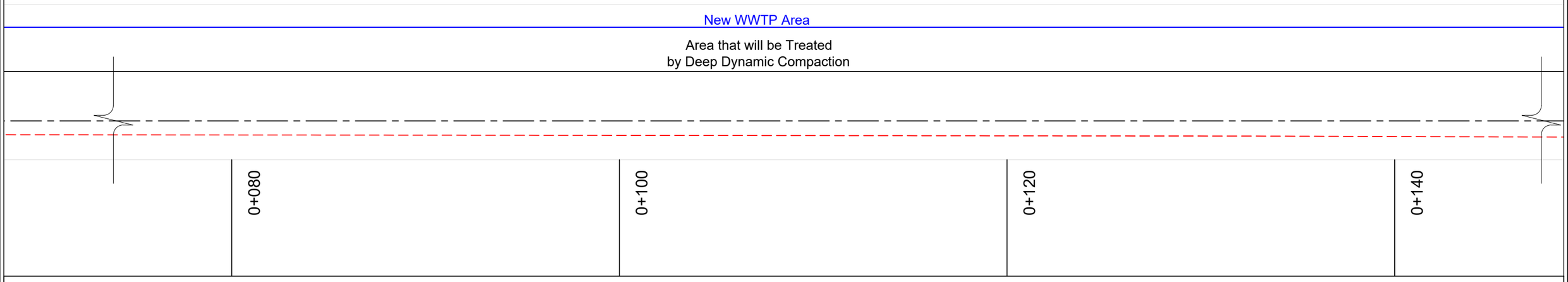
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APPROVED :	–APP–
DATE :	07 October 2024
SCALE :	1:200
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PROJECT	DIVISION	SUB–DIVISION	SHEET	REVISION
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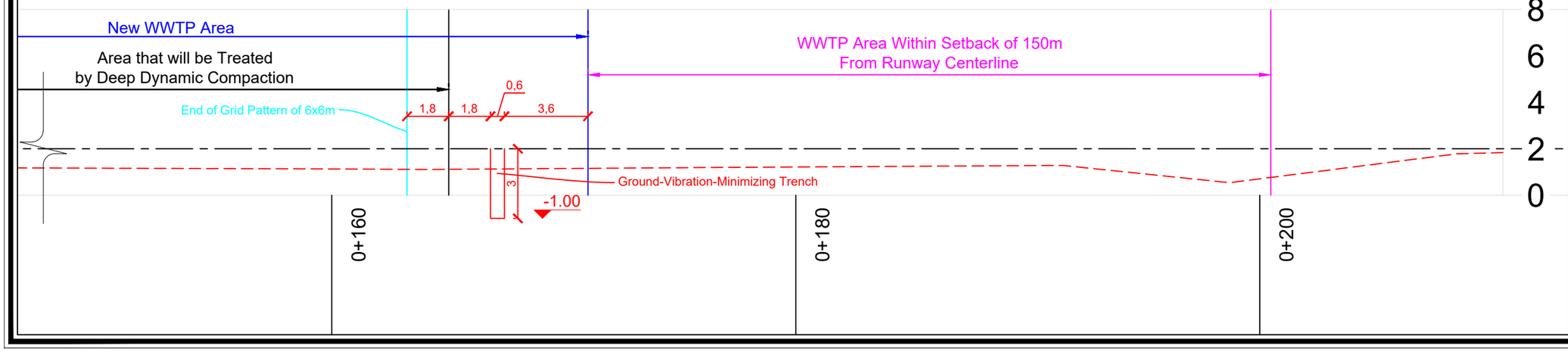
Section C



Section C



Section C



No	DATE	REVISIONS	ARCH	CIVIL	MECH	ELEC

LEBANESE REPUBLIC
COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

Soil Treatment For The "Expansion And Upgrade Of Al-ghadir Wastewater Treatment Plant Project"

DAR AL HANDASAH
NAZIH TALEB & PARTNERS
Founded 1956

ARTELIA

Deep Dynamic Compaction

Section C-C

DRAWN :	–DRN–
CHECKED :	–CHK–
APPROVED :	–APP–
DATE :	07 October 2024
SCALE :	1:200
FILE NAME	
DDC–S–04	

PROJECT	DIVISION	SUB–DIVISION	SHEET	REVISION
L2401DS	DDC	S	04	–REV–

CHAPTER 4 GEOTECHNICAL INVESTIGATION

Appendix 4.2 Logs of Borings

SATCON

Geotechnical Engineering and Contracting

LOG OF BORING

BOREHOLE: BH1/Ghadir-2024 **SHEET:** 1 of 1

DRILLING METHOD: Continuous core drilling (T2 86).

BOREHOLE DEPTH: 18m **INCLINATION/AZIMUTH:** 90/-

PROJECT: Expansion and Upgrade of AI - Ghadir WWTP

LOCATION: Ghadir - Aley Caza / Mount Lebanon

CLIENT: Council for Development and Reconstruction (CDR)

DESIGNER: Dar-Taleb

ENGINEER: Dar-Taleb

DRILL RIG: Mack MD7 **DRILLER:** N. Awad **GEOLOGIST:** M. Termos

CASING: 18m (OD: 128mm, ID: 119mm) **HOLE DIA.:** 86mm

CORE: 71.7mm (T2 86) **Rod:** NWJ (66.7mm)

SEAWATER DEPTH: 1.87m from EGL (September 17, 2024)

EXISTING GROUND LEVEL (EGL): +2.60

AS-BUILT COORDINATES X: -339492.5 Y: -36374.5

DATE STARTED / FINISHED: 16/09/2024 - 16/09/2024

Depth (m, Borehole Axis)	Sampling	Loss of Water Circulation	SPT / DCPT Number of Blows and Uncorrected SPT / DCPT Values	In-situ Testing: Lugeon	Permeability	Pressiometer	Dilatometer	Vane Shear	Casing	Open Standpipe Piezometer	Lithology	Symbol	TCR (%)	SCR (%)	RQD (%)	FRACTURE FREQUENCY
0											**Manmade Fill:** Loose to medium dense (according to penetration rate) Silty Sandy GRAVEL of intermediate plasticity with Cobbles and Boulders		40%			
1.5	T2 86		SPT: 26, 22, 28 50													
3.0	T2 86		SPT: 50/13cm Refusal													
4.5	T2 86		SPT: 21, 42, 45 >50								**Seabed Sediments:** Medium dense to dense (according to corrected SPT values for the increase resistance due to negative excess pore water pressure set up during the testing) Gravely very Silty fine SAND of intermediate plasticity.	Drill cuttings.				
6.0	T2 86		SPT: 31, 42,50/8cm Refusal													
7.5	T2 86															
9.0	T2 86		DCPT: 75/4cm Refusal													
10.5	T2 86		SPT: 18, 25, 45 >50								**Bedrock:** Beige highly weathered (occasionally disintegrated into soil) crushed and closely fractured weak to moderately strong medium to coarse grained vuggy Calcareous SANDSTONE / very Sandy LIMESTONE.		26%	26%	0%	Closely Fractured (Fr) and Crushed (Cr).
12.0	T2 86		SPT: 21, 50/6cm Refusal										30%	0%	0%	
13.5	T2 86		SPT: 18, 26, 31 >50										40%	22%	0%	
15.0	T2 86		DCPT: 75/4cm Refusal										67%	35%	0%	
16.5	T2 86												64%	47%	0%	
18.0	T2 86		**End of BH at 18.0m**										64%	34%	0%	
19.5																

Remarks:

No loss of water circulation.

GEOLOGIST	DATE	SIGNATURE
M. Termos	9/18/2024	

SATCON

Geotechnical Engineering and Contracting

LOG OF BORING

BOREHOLE: BH2/Ghadir-2024 **SHEET:** 1 of 1

DRILLING METHOD: Continuous core drilling (T2 86).

BOREHOLE DEPTH: 18m **INCLINATION/AZIMUTH:** 90/-

PROJECT: Expansion and Upgrade of AI - Ghadir WWTP

CASING: 18m (OD: 128mm, ID: 119mm) **HOLE DIA.:** 86mm

LOCATION: Ghadir - Aley Caza / Mount Lebanon

CORE: 71.7mm (T2 86) **Rod:** NWJ (66.7mm)

CLIENT: Council for Development and Reconstruction (CDR)

SEAWATER DEPTH: 0.68m from EGL (September 17, 2024)

DESIGNER: Dar-Taleb

EXISTING GROUND LEVEL (EGL): +1.50

ENGINEER: Dar-Taleb

AS-BUILT COORDINATES X: -339516.4 Y: -36185.1

DRILL RIG: Mack MD7 **DRILLER:** N. Awad **GEOLOGIST:** M. Termos

DATE STARTED / FINISHED: 17/09/2024 - 17/09/2024

Depth (m, Borehole Axis)	Sampling	Loss of Water Circulation	SPT / DCPT: Number of Blows and Uncorrected SPT / DCPT Values	In-situ Testing: Lugeon	Permeability	Pressiometer	Dilatometer	Vane Shear	Casing	Open Standpipe Piezometer	Lithology	Symbol	TCR (%)	SCR (%)	RQD (%)	FRACTURE FREQUENCY
0																
1.5	T2 86		DCPT: 7, 13, 28, 22, 75/5cm Refusal								**Manmade Fill:** Loose to medium dense (according to penetration rates) Silty Sandy GRAVEL of intermediate plasticity with Cobbles and Boulders		40%			
3.0	T2 86		SPT: 50/6cm Refusal										50%			
4.5	T2 86										**Seabed Sediments:** Medium dense to dense (according to penetration rates) Gravely very Silty fine SAND of intermediate plasticity.	Drill cuttings.				
6.0	T2 86															
7.5	T2 86		DCPT: 75/8cm Refusal													
9.0	T2 86															
10.5	T2 86		DCPT: 75/7cm Refusal										60%	15%	0%	
12.0	T2 86		SPT: 50/13cm Refusal										45%	27%	0%	
13.5	T2 86										**Bedrock:** Beige highly weathered (occasionally disintegrated into soil) crushed and closely fractured weak to moderately strong medium to coarse grained vuggy Calcareous SANDSTONE / very Sandy LIMESTONE.		64%	32%	0%	Closely Fractured (Fr) and Crushed (Cr).
15.0	T2 86		DCPT: 75/4cm Refusal										60%	47%	0%	
16.5	T2 86												64%	26%	0%	
18.0	T2 86		**End of BH at 18.0m**										64%	20%	0%	
19.5																

Remarks:

No loss of water circulation.

GEOLOGIST	DATE	SIGNATURE
M. Termos	9/18/2024	

SATCON

Geotechnical Engineering and Contracting

LOG OF BORING

BOREHOLE: BH3/Ghadir-2024 **SHEET:** 1 of 1

DRILLING METHOD: Continuous core drilling (T2 86).

BOREHOLE DEPTH: 18m **INCLINATION/AZIMUTH:** 90/-

PROJECT: Expansion and Upgrade of AI - Ghadir WWTP

LOCATION: Ghadir - Aley Caza / Mount Lebanon

CLIENT: Council for Development and Reconstruction (CDR)

DESIGNER: Dar-Taleb

ENGINEER: Dar-Taleb

DRILL RIG: Mack MD7 **DRILLER:** N. Awad **GEOLOGIST:** M. Termos

CASING: 18m (OD: 128mm, ID: 119mm) **HOLE DIA.:** 86mm

CORE: 71.7mm (T2 86) **Rod:** NWJ (66.7mm)

SEAWATER DEPTH: 0.58m from EGL (September 17, 2024)

EXISTING GROUND LEVEL (EGL): +1.00

AS-BUILT COORDINATES X: -339557.5 Y: -36025.3

DATE STARTED / FINISHED: 14/09/2024 - 15/09/2024

Depth (m, Borehole Axis)	Sampling	Loss of Water Circulation	SPT / DCPT Number of Blows and Uncorrected SPT / DCPT Values	In-situ Testing: Lugeon	Permeability	Pressiometer	Dilatometer	Vane Shear	Casing	Open Standpipe Piezometer	Lithology	Symbol	TCR (%)	SCR (%)	RQD (%)	FRACTURE FREQUENCY
0																
1.5	T2 86		DCPT: 22, 75/8cm Refusal								**Manmade Fill:** Loose to medium dense (according to penetration rates) Silty Sandy GRAVEL of intermediate plasticity with Cobbles and Boulders		30%			
3.0	T2 86		DCPT: 75/4cm Refusal										42%			
4.5	T2 86		SPT: 18, 23, 31 >50										60%			
6.0	T2 86		DCPT: 75/2cm Refusal													
7.5	T2 86															
9.0	T2 86															
10.5	T2 86										**Seabed Sediments:** Medium dense to dense (according to corrected SPT value for the increase resistance due to negative excess pore water pressure set up during the testing) Gravely very Silty fine SAND of intermediate plasticity.					
12.0	T2 86															
13.5	T2 86		SPT: 45, 48, 50/4cm Refusal													
15.0	T2 86															
16.5	T2 86		SPT: 43, 50/9cm Refusal													
18.0	T2 86		**End of BH at 18.0m**													
19.5																

Drill cuttings.

Remarks:

No loss of water circulation.

GEOLOGIST	DATE	SIGNATURE
M. Termos	9/18/2024	

SATCON

Geotechnical Engineering and Contracting

LOG OF BORING

BOREHOLE: BH4/Ghadir-2024 **SHEET:** 1 of 1

DRILLING METHOD: Continuous core drilling (T2 86).

BOREHOLE DEPTH: 18m **INCLINATION/AZIMUTH:** 90/-

PROJECT: Expansion and Upgrade of AI - Ghadir WWTP

LOCATION: Ghadir - Aley Caza / Mount Lebanon

CLIENT: Council for Development and Reconstruction (CDR)

DESIGNER: Dar-Taleb

ENGINEER: Dar-Taleb

DRILL RIG: Mack MD7 **DRILLER:** N. Awad **GEOLOGIST:** M. Termos

CASING: 18m (OD: 128mm, ID: 119mm) **HOLE DIA.:** 86mm

CORE: 71.7mm (T2 86) **Rod:** NWJ (66.7mm)

SEAWATER DEPTH: 0.60m from EGL (September 17, 2024)

EXISTING GROUND LEVEL (EGL): +1.25

AS-BUILT COORDINATES X: -339529.3 Y: -35899.5

DATE STARTED / FINISHED: 15/09/2024 - 15/09/2024

Depth (m, Borehole Axis)	Sampling	Loss of Water Circulation	SPT / DCPT: Number of Blows and Uncorrected SPT / DCPT Values	In-situ Testing: Lugeon	Permeability	Pressiometer	Dilatometer	Vane Shear	Casing	Open Standpipe Piezometer	Lithology	Symbol	TCR (%)	SCR (%)	RQD (%)	FRACTURE FREQUENCY
0	T2 86										**Manmade Fill:** Medium dense to dense (according to SPT values) Silty Sandy GRAVEL of intermediate plasticity with Cobbles and Boulders		33%			
1.5			SPT: 4, 8, 12 20													
3.0	T2 86		SPT: 17, 21, 25 46										25%			
4.5	T2 86		SPT: 22, 35, 50/4cm Refusal										20%			
6.0	T2 86		DCPT: 38, 52, 75/4cm Refusal													
7.5	T2 86															
9.0	T2 86															
10.5	T2 86		SPT: 31, 35, 43 >50								**Seabed Sediments:** Medium dense to dense (according to corrected SPT value for the increase resistance due to negative excess pore water pressure set up during the testing) Gravely very Silty fine SAND of intermediate plasticity.					
12.0	T2 86		SPT: 29, 45, 50/8cm Refusal													
13.5	T2 86															
15.0	T2 86															
16.5	T2 86															
18.0	T2 86		**End of BH at 18.0m**													
19.5																

Drill cuttings.

Remarks:

No loss of water circulation.

GEOLOGIST	DATE	SIGNATURE
M. Termos	9/18/2024	

CHAPTER 4 GEOTECHNICAL INVESTIGATION

Appendix 4.3 Photos of Core Boxes

BH1



Box 1_0 to 15m



Box 2_15 to 18m

BH2



Box 1_0 to 13.5m



Box 2_13.5 to 18m

BH3



Box 1_0 to 18m

BH4



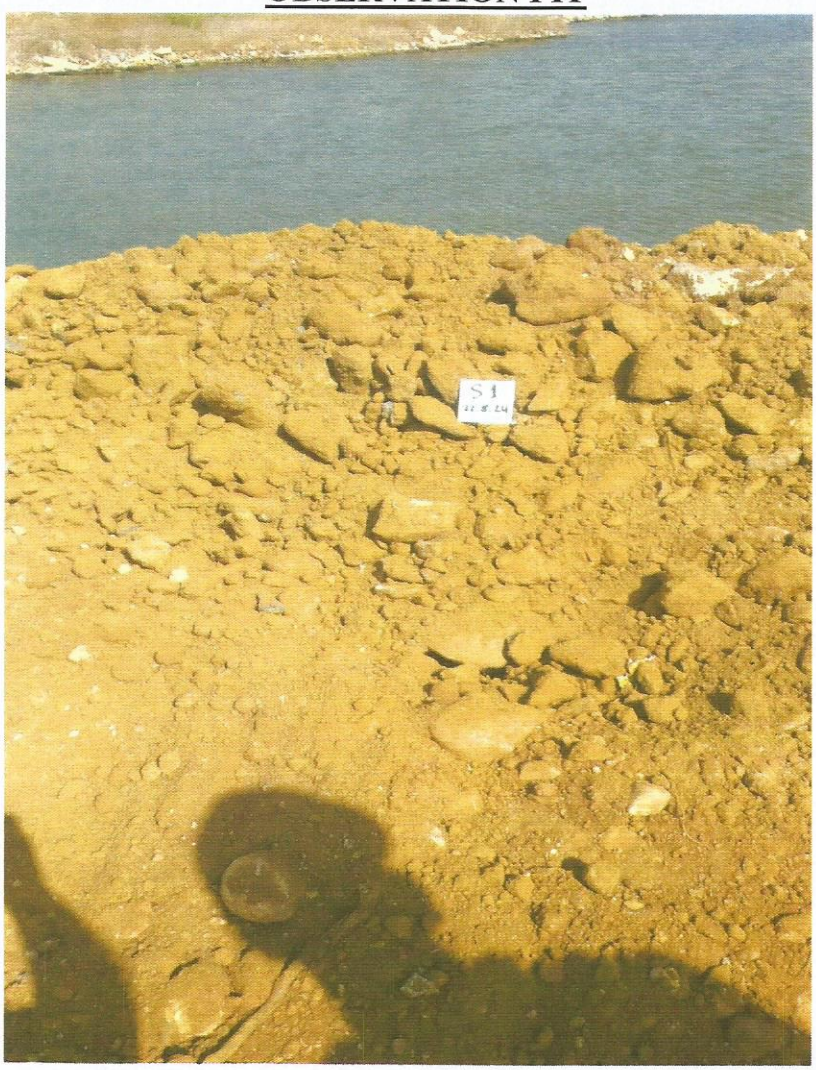
Box 1_0 to 18m

CHAPTER 4 GEOTECHNICAL INVESTIGATION

Appendix 4.4 Laboratory Test Results

Client	: Council For Development And Reconstruction.
Project	: Expansion And Upgrade of A1 - Ghadir WWTP
Engineer	: Dar Al Handasah Nazih Taleb & Partners.
Location	: Ghadir
Materials	: Backfill -S1 (Rarely Used).
Source	: Site Stockpile
Sampled By	: Engineer's and Lab's representatives
Sampling date	: 22/08//2024

OBSERVATION PIT



Technician

Lab Director
Bassam Machaalany

02 SEP 2024

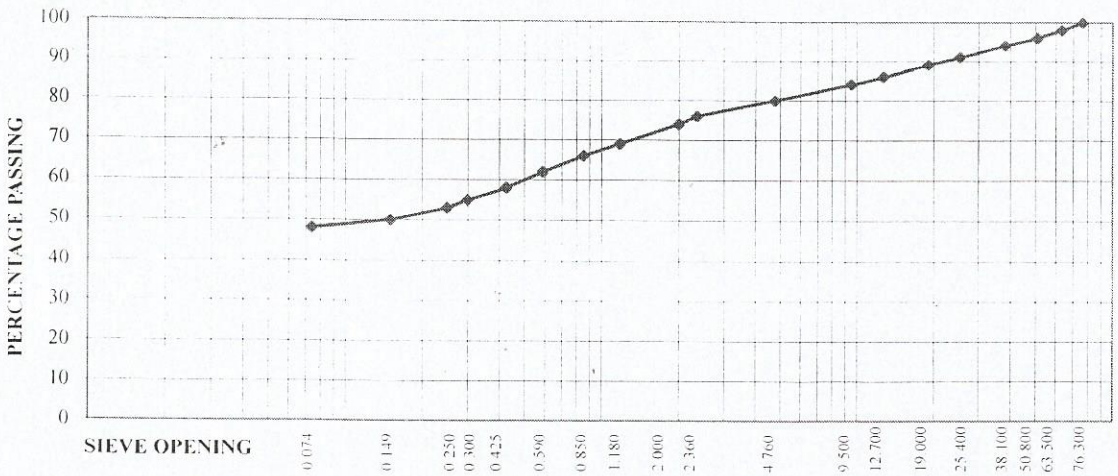
MACHAALANY LABORATORIES
Civil Engineering Materials Testing

مختبرات مشعلاني
إختبارات مواد الهندسة المدنية

Client : Council For Development And Reconstruction.
Project : Expansion And Upgrade of Al - Ghadir WWTP
Engineer : Dar Al Handasah Nazih Taleb & Partners.
Location : Ghadir
Materials : Backfill -S1 (Rarely Used).
Source : Site Stockpile
Sampled By : Engineer's and Lab's representatives
Sampling date : 22-08-24

SIEVE ANALYSIS

AASHTO (T - 27)



Boulders 200mm and Up	2%

Cobbles 75 to 200mm	10%

SIEVE inch	SIEVE mm	PASSING %
3"	76.300	100
2 1/2"	63.500	98
2"	50.800	96
1 1/2"	38.100	94
1"	25.400	91
3/4"	19.000	89
1/2"	12.700	86
3/8"	9.500	84
4	4.760	80
8	2.360	76
10	2.000	74
16	1.180	69
20	0.850	66
30	0.590	62
40	0.425	58
50	0.300	55
60	0.250	53
100	0.149	50
200	0.074	48.00

Lab Technician

Lab Director
Bassam Machaalany

02 SEP 2024

MACHAALANY LABORATORIES
Civil Engineering Materials Testing

مختبرات مشعلاني
إختبارات مواد الهندسة المدنية

Client : Council For Development And Reconstruction.
Project : Expansion And Upgrade of Al - Ghadir WWTP
Engineer : Dar Al Handasah Nazih Taleb & Partners.
Location : Ghadir
Materials : Backfill -S1 (Rarely Used).
Source : Site Stockpile
Sampled By : Engineer's and Lab's representatives
Sampling date : 22-08-24

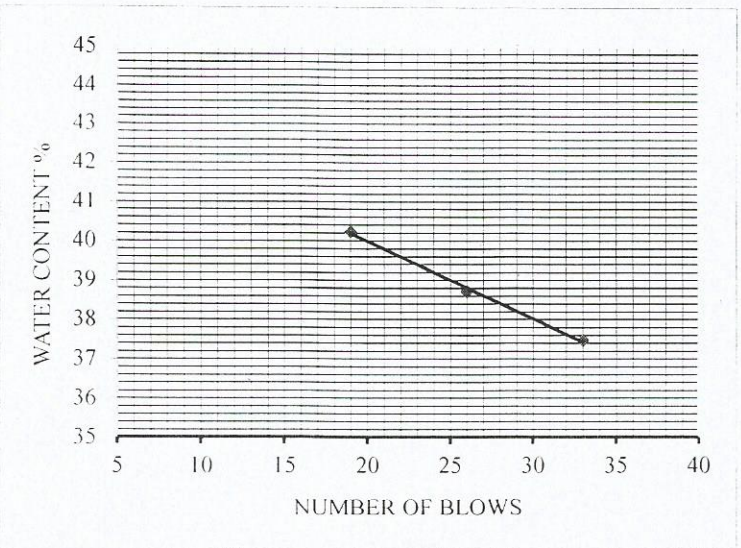
SOIL CLASSIFICATION / ATTERBERG LIMITS (AASHTO T89/T90)

LIQUID LIMIT

		1	2	3	4	5
CONTAINER NUMBER		G	U	N		
NUMBER OF BLOWS		19	26	33		
WT.OF WET SAMPLE + CONTAINER	Gms	39.10	36.58	37.43		
WT.OF DRY SAMPLE + CONTAINER	Gms	31.12	29.90	30.51		
WT.OF WATER	Gms	7.98	6.68	6.92		
WT.OF CONTAINER	Gms	11.29	12.65	12.05		
WT.OF DRY SAMPLE	Gms	19.83	17.25	18.46		
WATER CONTENT	%	40.24	38.72	37.49		

PLASTIC LIMIT

		1	2	3	4	5
CONTAINER NUMBER		C	O			
WT.OF WET SAMPLE + CONTAINER	Gms	36.84	38.07			
WT.OF DRY SAMPLE + CONTAINER	Gms	31.68	32.55			
WT.OF WATER	Gms	5.16	5.52			
WT.OF CONTAINER	Gms	11.82	11.52			
WT.OF DRY SAMPLE	Gms	19.86	21.03			
WATER CONTENT	%	25.98	26.25			



LIQUID LIMIT	39
PLASTIC LIMIT	26
PLASTICITY INDEX	13
SOIL CLASSIFICATION	A-6

Clayey Soils.

Lab Director
Bassam Machaalany

02 SEP. 2024

Lab Technician

MACHAALANY LABORATORIES
Civil Engineering Materials Testing

مختبرات مشعلاني
إختبارات مواد الهندسة المدنية

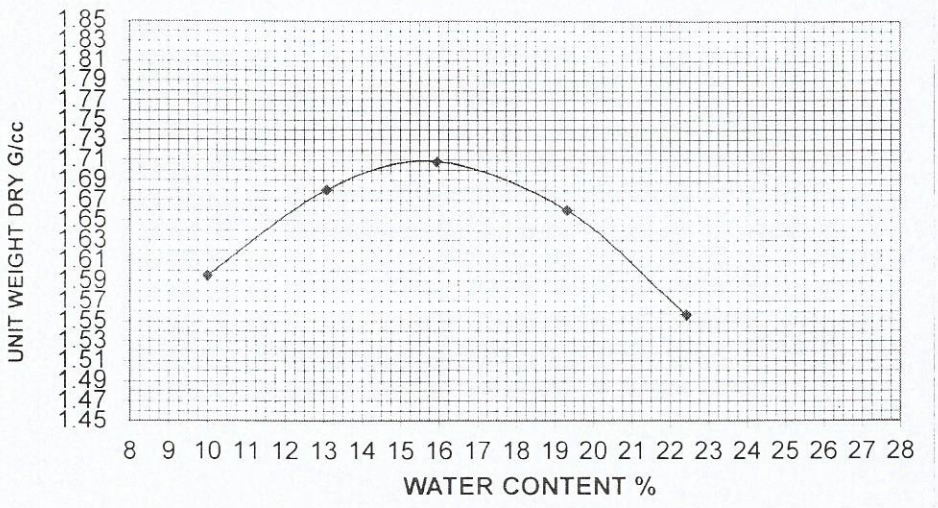
Client : Council For Development And Reconstruction.
: Expansion And Upgrade of Al - Ghadir WWTP
Engineer : Dar Al Handasah Nazih Taleb & Partners.
Location : Ghadir
Materials : Backfill -S1 (Rarely Used).
Source : Site Stockpile
Sampled By : Engineer's and Lab's representatives
Sampling date : 22-08-24

MOISTURE DENSITY RELATION OF SOIL (AASHTO T180 Method C)

Cylinder No		1	2	3	4	5		
Volume	Cm^3	2123						
Method Of Compaction		MODIFIED PROCTOR						
Wt.Cylinder + Soil	Gms	10770	11080	11250	11250	11090		
Wt Of Cylinder	Gms	7045	7045	7045	7045	7045		
Wt Of Compacted Soil	Gms	3725	4035	4205	4205	4045		
Unit Weight Wet	G/Cm^3	1.75	1.90	1.98	1.98	1.91		
Dish Number		1	2	3	4	5		
Wt.Sample (Wet + Dish)	Gms	1432	1587	1362	1404	1397		
Wt.Sample (Dry + Dish)	Gms	1342	1451	1229	1239	1210		
Wt.Of Water	Gms	90	136	133	165	187		
Wt Of Dish	Gms	442	412	395	385	376		
Wt Of Dry Soil	Gms	900	1039	834	854	834		
Water Content	%	10.0	13.1	15.9	19.3	22.4		
Unit Weight Dry	G/Cm^3	1.60	1.68	1.71	1.66	1.56		

Maximum Dry Density (g/cm^3)	1.71

Optimum Water Content (%)	15.9



Lab Director
Bassam Machaalany

02 SEP. 2024

Lab Technician