Detailed account of studies related groundwater in al-Khalifa

This Report aims to list the problems related to ground water in the areas of al-Khalifa and Zeinhoum; whether they were problems of water overflow (appearing in basements/ground floors/open spaces), or problems that may be causes of water overflow (networks/potholes/tanks). As well as all the studies carried out through the groundwater research project or compiled from previous projects.

For relevant information refer to the following Annexes:

Annex 1: Map of all the places with water problems with pictures and locations
Annex 2: Sections showing the street, monuments, and water levels of these areas
Annex 3: Water Analyses
Annex 4: Boreholes from previous projects
Annex 5: Water flow rate from an existing dewatering project in the area

1. Groundwater problems in Khalifa

Ground Water overflows appear in several places along al-Khalifa Street (12 spotted). In addition, rising damp resulting from ground water poses a threat to a many other buildings. This is due to the streets altitude which is lower than surrounding areas. In most cases these are places lower than the street level (monuments/basements). Below are the most notable cases.

- a. Al-Ashraf Khalil and Fatima Khatun Domes
- The two domes near al-Sayyida Nafisa square lie next to the site for Khalifa Heritage and Environment Park and suffer from rising damp, cracks as well as ground water overflow appearing in their surroundings.
- A pisometer is installed next to Fatima Khatun Dome shows a water level beneath the ground level by 2.5 to 2.9 m. and water samples taken from it were analysed. In addition, a pisometer was installed east of Fatima Khatun pisometer in the cemetery area to compare water levels.



- b. Al-Sayyida Ruqayya Dome:
 - Street level: +516 cm (zero = al-Saliba Street).
 - Monument level: +426 cm.
 - Ground water level (borehole): +316.
 - Ground water overflow level (neighboring empty land): +616; the water level appearing above the ground in this area, which is neighboring to the Zaynhum area, is higher than the street level.
 - Effects of rising damp appear on the monument's walls up to a height of 2 meters.



- According to local accounts, water overflows appeared several times in the S. Ruqayya Dome area, the earliest they can date is in 2012 at the time of the *mawlid* (festival), the last was in march 2017 (also the time of the *mawlid*), where the water company detected a pipe breakage and got it fixed, thereby stopping the overflow.
- Boreholes were made in this site in 2005 and 2016, and water samples from the overflowing water were analysed.



- c. Shajar al-Durr school
- Water overflow appears periodically (almost yearly) in the southern and eastern sides of the school yard, and the ground floor classes.
- School sanitation is in a bad shape with water supply and sewage pipes seeping continuously
- The School is side to side to a wood factory (no. 4), whose basement is covered in water with a level higher than the water in the school by 20 cm



• Water levels in the school at the current moment decreased, the school is being rehabilitated for studying by cleaning the effects of water and removing undesired plants. While it is being planned to install pumps by the Cairo Governorate by the end of studying in summer to regulate the water level.



- d. Wood factory (6 Darb el-Bazabiz)
 - The Wood factory basement with an area of 1400 m2 is covered with water with a height of 2 meters. According to local accounts, a water pipe in the street next to the factory has been

broken for years. The factory's water level is higher than that of the school by 20 cm, next to the factory is also an empty land plot where plants grow organically.



- e. Ahmed Kohya mosque
- The mosque is the only structure in the area with a complete dewatering system, that decreases the water level by 3.7 meters, pumping 300 cubic meters daily



- f. Residential buildings
- 23 el-Rokbeyya Street; Residents increased the 500 m² basement floor level by 1m and applied insulation, water still appears in small areas on the ground
- 37 el-Rokbeyya Street; Residents pump water out of the 173 m² basement every 4-6 weeks. The water reaches a height of about 1m and stops increasing in level.
- 20 al-Khalifa Street; basement is covered in water to a level below street level by 156 cm



- g. Other cases:
- Saffiy el din Gohar dome also suffer from overflowing water, a pisometer was installed there, and water samples from it were analyzed.
- A deserted Factory next to S. Ruqayya Dome and neighboring Zainhum has water appearing with water level higher than street level
- A basement in a wood workshop (69 Darb el-Masdud) next to zeinhom is covered in water
- A pisometer was installed east of Fatima Khatun pisometer in the cemetery area to compare water levels



- h. Inspection chambers:
- Many inspection chambers, especially in alleyways and between houses, aren't isolated or covered with a cement layer, and suffer from continuous clogging, few of those were spotted; Atfet berto bek and next to Fatima Khatun dome.
- In The area of Arba'een shrine, sewage water overflows happen every month or two





2. Groundwater problems in Zaynhum

The public housing area, which was built on a hill higher than neighboring areas, was built on different phases through the 80s and the 90s. At least two buildings of the project were demolished due to structural problems caused by water resulting from bad sanitation. In the S. Ruqayya and S. Nafisa areas the water level is higher near the Zaynhum area. Below are problems in the network that were spotted in the area.

• According to local accounts the Zaynhum garden irrigation system used to work without taps. The overflow of water was suspected to cause structural problems, and the action taken by the water company was closing the openings of these irrigation pipes and burying it. Some of these pipes can now be spotted overflowing with water, while others are diverted by the residents to water their gardens.



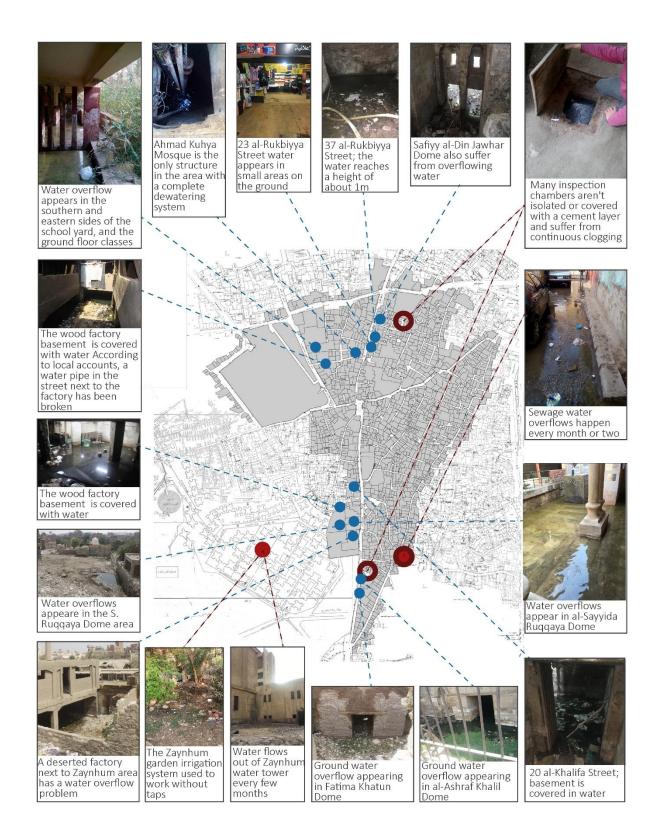
- According to local accounts, water flows out of the neighborhood water tower every few months. This is due to a problem with the water level regulator. Traces of the water appear on the building and the surrounding areas contain water ponds, soil failures and plants growing organically.
- The poor state of sanitation in the Zaynhum area appears in the damp spots on the building facades.



• The poor state of sanitation in the Zaynhum area appears in the damp spots on the building facades.

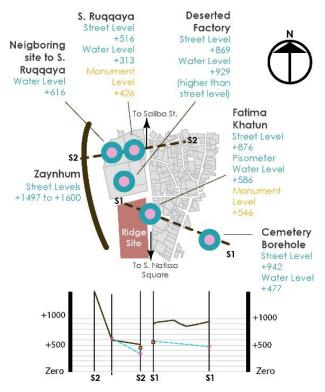


Annex 1: Map of all the places with water problems with pictures and locations

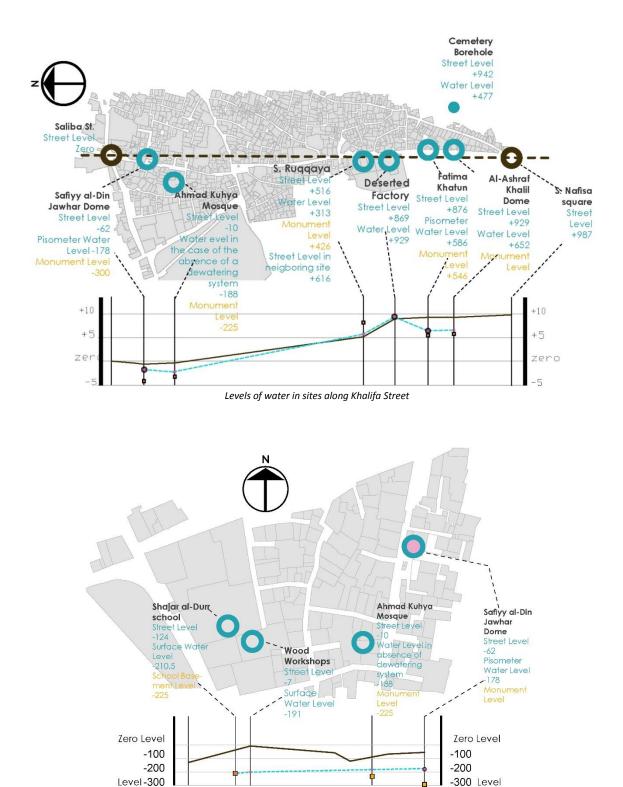


Annex 2: 3. Water levels

Water Levels in several sites next to the ridge are listed below, water levels along east-west axes appear to increase towards the west (hence Zaynhum) in a significant way.



Levels of water in sites arround Khalifa Heritage and Environment Park



Sections in the northern part of the street

Annex 3: Water Analyses

Below is the water analysis report for a sample taken from the pisometer next to Fatima Khatun Dome, across the street from the site for the Khalifa Heritage and Environment Park. Compared to a sample taken from another site (Safiyy al-Din Jawhar Dome) in the northern section of the study area.

		wastewater	Fatima	Khatun	Safiyy al-	Din Jawhar
Chemical Test	WHO (ppm)	(mg/L-1)	results	unit	results	unit
PH	6.5-8.0	6.0-9.0	7.47		7.27	
TDS	100-600	300-900	2650	mg/l	1020	mg/l
TSS			2236	mg/l	280	mg/l
COD	<10	1000	987	mg/l	331	mg/l
BOD	<6	110-400	<0.5	mg/l	<0.5	mg/l
Turbidity			184	1/m	13.7	1/m
Cl ⁻¹ (chloride)	-	100	951.4	mg/l	142	mg/l
NH₄ ⁺ (Ammonia)	1.5	12.0-80	1.2	mg/l	0.9	mg/l
NO ₃ ⁻¹ (Nitrate)	50	20-40	5	mg/l	1.8	mg/l
Oil and Grease		100	24	mg/l	12	mg/l
Bicarbonate			976	mg/l	732	mg/l

Conclusions

- 1. The water found is not underground water, for a number of reasons:
 - a. Total dissolved solids (TDS) ratios in underground water should be between 1000 and 1500 mg/l, while results show TDS ratios of 2650 mg/l for the Fatima Khatun site and 1020 mg/l for the Safiyy al-Din Jawhar site.
 - b. Total suspended solids (TSS) ratios vary from 6 to 30 gm/l in underground water. Which did not happen in either site (2 gm/l for the Fatima Khatun site and 0.2 gm/l for the Safiyy al-Din Jawhar site)
 - c. Bicarbonates ratio in underground water varies from 300 to 640 mg/l which is much less than the amounts in the above table
 - d. Turbidity should not exceed 12 gm/l which also did not happen in either site
- Water from the Safiyy al-Din Jawhar site is purer than the water from the Fatima Khatun site. However, analysis shows that water from both sites does not reach in their contamination levels the levels of waste water, for the following reasons:
 - a. Wastewater has high levels of BOD (500 to 1000 gm/l), while both samples had a BOD of less than 0.5 mg/l. Wastewater also has high values of COD (reaching 1500 mg/l) while in both sites it didn't exceed 900 mg/l.
 - b. Wastewater has high ratios of Ammonia reaching 80 mg/l. While this ratio didn't exceed 1 mg/l in both sites.
 - c. Oil and grease ratios in wastewater reaches 100 mg/l. While it didn't exceed 24 mg/l in either site.

From the above we deduce that the extracted water is not underground, it is also not wastewater, but rather contaminated water that needs treatment to be used. It is most likely that this water is drinking water that got polluted. This appears from the pH value of 7 for the water. It is also noted that turbidity values ae directly proportional with chorine values, and chlorine is the most common method for water treatment for drinking purposes.

Annex 4: Boreholes from previous projects

Boreholes in the Sayyida Ruqayya site

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Proj Bori			:	(2)	<i>آ</i> ي	ة رقب	السيد	مسجد	SOIL LABORATOR	RY] round Water : (I) : (F) نمتر ۲.۱۰ 2.1 m
(t/m ³)	(kg / cm ²)	WL-W P- WS	% M	REC / RQD	Type	Bottom Level	Thickness	Legend	Descriptio	in
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					Core Core Core	_	5			ردم (رمل طبیی – کسر حجر ج –زنط متدرج –بغایا عضویهٔ) بن
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2.49	250				Core Core Core	8.5	10			
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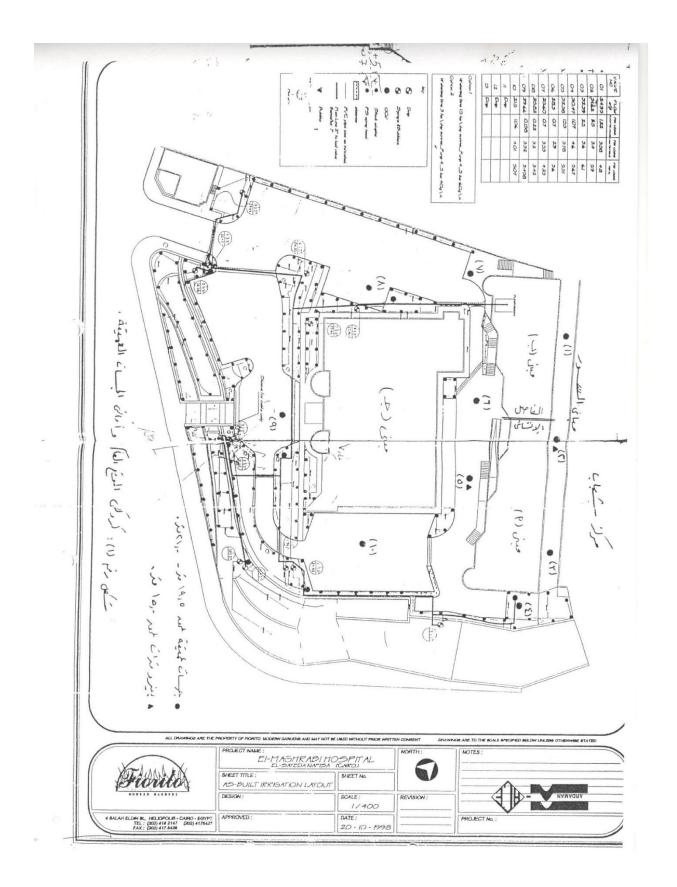
Boreholes in the Maghrabi hospital bulding (near Sayyida Nafisa square and with ground level +1560 cm from Saliba street (zero for all levels in these studies)

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5_					Å			reddish brown.
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0	7		48	C5	\bigotimes			- From 6.0 m to 7.0 m becomes silty clay, sand, limestone pieces,
7					\square			plastic bags, organic matter. dark brown.
8	8		44			20		- From 7.0 m to 10.0 m becomes silty clay, sand, limestone and red brick pieces, traces of plant roots and seeds, organic matter.
°	9		51	C6	\bigtriangledown	14.50		dark brown to black.
9					\square			
10 -	10		53	C7	X			
_	11		33					- From 10.0 m to 11.0 m becomes silty clay, sand, limestone fragments
11	12	<i></i>	33	C8				brown. - From 11.0 m to 12.0 m becomes silty clay, limestone fragments,
12 -	12		22	Co	X			organic matter, brown.
_	13		37					- From 12.0 m to 14.0 m becomes silty clay, limestone pieces. brown.
13	14		21					
14	14		21					
-	15		23					- From 14.0 m to 15.0 m becomes silty clay, sand, red brick pieces.
15	16		82					dark brown. - From 15.0 m to 15.5 m becomes red brick pieces. red.
16_				C9	X			<u>Clav:</u> silty, some fine sand, calcareous, with limestone fragments.
17 -					$\langle \rangle$	1.00		gray. Limestone Pieces: weak, weathered, with interlayers of calcareous
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18_					\square		A -	
				C11	\mathbf{X}	0.70		Limestone: moderately weak, weathered. yellow.
_				C12	$\langle \rangle$	1.80	AA	Limestone Pieces: weak, weathered, with interlayers of calcareous

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 4 4 9 C4 From 3.0 m to 6.0 m becomes silty clay, sand, limestone and red brick pieces. dark brown to black. From 6.0 m to 7.0 m becomes fine silty sand, silty clay, limestone pieces, traces of plant roots. black. From 7. 23 C8 7 23 C8 7 23 C8 9 29 C10 From 10.0 m to 8.2 m becomes fine silty sand, silty clay, plant roots and seeds. brown. From 9.3 m to 10.3 m becomes fine silty sand, silty clay, plant roots and seeds. brown. From 10.3 m to 13.0 m to 13.0 m becomes silty clay, sand, limestone pieces. brown and white. From 13.0 m to 14.0 m becomes silty clay, and, limestone pieces. brown and white. From 13.0 m to 14.0 m becomes silty clay, and, limestone pieces. brown and white. From 13.0 m to 14.0 m becomes silty clay, and, red brick pieces, traces of limestone fragments. dark brown. From 14.8 to 15.8 m becomes red brick pieces, red. C13 C14 C14 Limestone Pieces: in boulder size, with interlayers of sandy silty clay. yellow. Clay: silty, some fine sand, traces of limestone fragments. 	-	3		25	C3	\mathbb{N}	1			and, coarse gravel. da	rk
4 US1 I 5 US2 I 6 21 C7 7 23 C8 7 23 C8 7 23 C8 8 41 C9 9 29 C10 9 29 C10 9 29 C10 11 9 29 12 US3 I 13 10 16 C11 14 10 16 C11 15 10 16 C11 14 10 16 C11 14 10 16 C11 15 17 16 C12 16 C13 C14 Interstone From 13.0 m to 14.0 m becomes silty clay, sand, red brick pieces, rad. 17 17 17 Interstone From 14.0 m to 14.8 m becomes silty clay	3			0		$ \left(\right) $	k				
 US1 I US2 I C5 C6 C7 C6 C1 C7 C3 C3 C3 C4 C9 C10 C11 C23 C3 C4 C9 C10 C11 C11 C12 C12 C13 C14 C14<td>4</td><td>4</td><td></td><td>9</td><td>C4</td><td>IX</td><td></td><td></td><td></td><td>and, limestone and rec</td><td>1</td>	4	4		9	C4	IX				and, limestone and rec	1
5 US2 I C5 -		US1	I			K	×		onex pieces, dark brown to black.		
6 5 16 C6 7 6 21 C7 8 7 23 C8 9 8 41 C9 10 9 29 C10 11 9 29 C10 12 US3 I I 13 10 16 C11 14 C12 C12 C12 15 C13 C14 C14 17 C14 C14 Limestone Pieces: Instances of limestone fragments. 19 10 C14 C14 Limestone Pieces: Instances of limestone fragments. 10 C14 C14 C14 Limestone Pieces: Instances of limestone fragments. 10 C14 C14 Limestone Pieces: Instances of limestone fragments. Clay: 11 C14 C14 Limestone: Instance Sightly weathered, moderately weak. yellow.	-										
7 5 16 C6 15.80 - From 6.0 m to 7.0 m becomes fine silty sand, silty clay, limestone pieces, traces of plant roots. black. 8 7 23 C8 - From 7.0 m to 8.2 m becomes silty clay, sand, limestone fragments. brown. 9 8 41 C9 - From 9.3 m becomes silty clay with limestone pieces. brown and white. 9 29 C10 - From 10.3 m to 10.3 m becomes silty clay, sand, limestone and red brick pieces. dark brown to black. 12 US3 I - - From 13.0 m to 14.0 m becomes silty clay, sand, red brick pieces, traces of limestone fragments. dark brown. 15 10 16 C11 - From 14.8 m becomes silty clay, sand, red brick pieces, traces of limestone fragments. dark brown. 15 - From 14.0 m to 14.8 m becomes red brick pieces. red. - From 14.8 to 15.8 m becomes red brick pieces. red. 16 - C13 - C14 - I.10 - Eimestone Fieces: in boulder size, with interlayers of sandy silty clay. yellow. 19 - C14 - I.10 - Eimestone: slightly weathered, moderately weak. yellow.	_	US2	I		C5	∇	1				
7 6 21 C7 15.80 pieces, traces of plant roots. black. 9 7 23 C8 - From 7.0 m to 8.2 m becomes silty clay, sand, limestone fragments. brown. 9 8 41 C9 - From 8.2 m to 9.3 m becomes fine silty sand, silty clay, plant roots and seeds. brown. 9 8 41 C9 - From 9.3 m to 10.3 m becomes silty clay with limestone pieces. brown and white. 9 10 9 29 C10 - From 13.0 m to 13.0 m becomes silty clay, sand, limestone and red brick pieces. dark brown to black. 12 US3 I - - From 13.0 m to 14.0 m becomes silty clay, sand, red brick pieces. brown and white. 14 10 16 C11 - From 14.0 m to 14.8 m becomes silty clay, sand, red brick pieces. traces of limestone fragments. dark brown. 15 - C13 - Imestone Pieces: in boulder size, with interlayers of sandy silty clay. yellow. 19 - C14 1.10 Limestone: slightly weathered, moderately weak. yellow. 19 - Silty, some fine sand, traces of limestone fragments.	6					\square					
6 21 C7 8 7 23 C8 9 8 41 C9 10 9 29 C10 11 9 29 C10 11 9 29 C10 11 9 29 C10 11 9 29 C10 12 US3 I 16 13 10 16 C11 14 C12 - From 13.0 m to 14.0 m becomes silty clay and limestone pieces. brown and white. - From 14.0 m to 14.8 m becomes silty clay, sand, red brick pieces, traces of limestone fragments. dark brown. - From 14.0 m to 14.8 m becomes red brick pieces. red. 16 1.70 17 1.10 18 1.10 19 1.10	-	5		16	C6	\mathbb{X}				nd, silty clay, limestor	ne
 8 7 23 C8 brown. From 8.2 m to 9.3 m becomes fine silty sand, silty clay, plant roots and seeds. brown. From 9.3 m to 10.3 m becomes silty clay with limestone pieces. brown and white. From 10.3 m to 13.0 m becomes silty clay, sand, limestone and red brick pieces. dark brown to black. 12 US3 I 10 16 C11 C12 C13 C14 C14 Limestone Pieces: in boulder size, with interlayers of sandy silty clay. yellow. Limestone: slipty clay. sand, red brick pieces, red. C12 C14 Limestone: slipty weathered, moderately weak. yellow. Clay: silty, some fine sand, traces of limestone fragments. 	/	6		21	C7	\leftrightarrow	15.80			and limestone fragme	nte
 From 8.2 m to 9.3 m becomes fine silty sand, silty clay, plant roots and seeds. brown. From 9.3 m to 10.3 m becomes silty clay with limestone pieces. brown and white. From 10.3 m to 13.0 m becomes silty clay, sand, limestone and red brick pieces. dark brown to black. US3 I US3 I 10 16 C11 C12 C12 C13 C11 C14 C14 C14 C14 C14 <li< td=""><td>8</td><td>0</td><td></td><td>21</td><td>CI</td><td>Х</td><td></td><td></td><td></td><td>and, minestone magnic</td><td>ms.</td></li<>	8	0		21	CI	Х				and, minestone magnic	ms.
 8 41 C9 9 29 C10 9 29 C10 11 - 9 12 29 C10 13 10 16 C11 16 C11 16 C12 16 C12 17 16 C12 18 17 17 18 10 16 C11 10 16 C11 11 16 C11 11 16 C11 11 16 C11 12 10 16 C11 14 10 16 C11 15 17 16 C12 16 16 C11 17 16 C12 18 16 C13 19 16 C14 10 16 C14 10 16 C11 10 16 C11 11 16 C11 12 16 C11 13 10 16 C11 14 16 C11 14 16 C11 15 16 C12 16 16 C11 17 16 C12 17 16 17 18 18 16 15.8 m becomes silty clay, sand, red brick pieces, traces of limestone fragments. dark brown. 10 16 C13 11 10 17 18 11 10 18 11 10 19 11 10 19 11 10 11 	_	7		23	C8	$\overline{\nabla}$	1		- From 8.2 m to 9.3 m becomes fine silty sa	nd, silty clay, plant roo	ots
10 9 29 C10 brown and white. 11 9 29 C10 - From 10.3 m to 13.0 m becomes silty clay, sand, limestone and red brick pieces. dark brown to black. 12 US3 I - From 13.0 m to 14.0 m becomes silty clay and limestone pieces. brown and white. 13 10 16 C11 - From 13.0 m to 14.0 m becomes silty clay, sand, red brick pieces. brown and white. 15 15 C12 - From 14.0 m to 14.8 m becomes silty clay, sand, red brick pieces, traces of limestone fragments. dark brown. 16 C12 - From 14.0 m to 14.8 m becomes red brick pieces. red. 16 C13 - From 14.8 to 15.8 m becomes red brick pieces. red. 17 - From 14.8 to 15.8 m becomes red brick pieces. red. - From 14.8 to 15.8 m becomes red brick pieces. red. 18 - C14 1.10 Limestone: slightly weathered, moderately weak. yellow. 19 - Clay: silty, some fine sand, traces of limestone fragments.	9					\triangle			and seeds. brown.		
 9 29 C10 From 10.3 m to 13.0 m becomes silty clay, sand, limestone and red brick pieces. dark brown to black. 12 US3 I 10 16 C11 C12 C12 C13 C14 C14<td>-</td><td>8</td><td></td><td>41</td><td>C9</td><td>\mathbb{N}</td><td>]</td><td></td><td></td><td>with limestone pieces.</td><td></td>	-	8		41	C9	\mathbb{N}]			with limestone pieces.	
11 12 US3 I <td>10</td> <td>0</td> <td></td> <td>20</td> <td>C10</td> <td>\leftrightarrow</td> <td></td> <td></td> <td></td> <td>and limastana and</td> <td>no d</td>	10	0		20	C10	\leftrightarrow				and limastana and	no d
12US3 I 1310 16 C11 141516 10 16 C11 1516171718 C12 - From 13.0 m to 14.0 m becomes silty clay and limestone pieces. brown and white. 16171718 C12 - From 14.0 m to 14.8 m becomes silty clay, sand, red brick pieces, traces of limestone fragments. dark brown. 181718 C14 1.70 Difference Pieces: in boulder size, with interlayers of sandy silty clay. yellow. 191910 C14 1.10 Limestone: slightly weathered, moderately weak. yellow.	11 -	9		29	C10	Х				, sand, limestone and i	red
US3 I 10 II C C11 14 II C C12 15 C C12 16 C11 17 C C12 17 C C13 18 C C14 19 C C14 10 C C14 10 C C11 10 C C11 10 C C12 10 C									brick preces, dark brown to black.		
 131016161616161	12										
10 16 C11 - From 13.0 m to 14.0 m becomes silty clay and limestone pieces. 14 - - From 13.0 m to 14.0 m becomes silty clay, and, red brick pieces, brown and white. - From 14.0 m to 14.8 m becomes silty clay, sand, red brick pieces, traces of limestone fragments. dark brown. 15 - - From 14.0 m to 14.8 m becomes silty clay, sand, red brick pieces, traces of limestone fragments. dark brown. 16 - - From 14.8 to 15.8 m becomes red brick pieces. red. 17 - - 18 - C14 19 - Clay: 19 - Clay:	_ 1	US3	I								
14	_	10		16	011	~			From 12.0 m to 14.0 m house attended	and limesters sizes	
 From 14.0 m to 14.8 m becomes silty clay, sand, red brick pieces, traces of limestone fragments. dark brown. From 14.8 to 15.8 m becomes red brick pieces. red. 	-	10		16	CII	X				and limestone pieces.	
15						$(\rightarrow$				sand, red brick pieces	5,
16	15_				C12	X					
C13 Limestone Pieces: in boulder size, with interlayers of sandy silty clay. yellow. 17	_					\square			- From 14.8 to 15.8 m becomes red brick pie	eces. red.	
18 C14 Limestone: slightly weathered, moderately weak. yellow. 19 Clay: silty, some fine sand, traces of limestone fragments.	16					\bigvee					
18	17 -				C13	Å	1 70		Limestone Pieces: in boulder size, with in	terlayers of sandy silty	7
18 C14 1.10 Limestone: slightly weathered, moderately weak. yellow. 19 Clay: silty, some fine sand, traces of limestone fragments.	· /					$\left(\rightarrow \right)$	1.70	BA	clay. yenow.		
	18				C14	X	1.10		Limestone: slightly weathered, moderately	weak. yellow.	
	-					$\left(\right)$			Class silty some fine and traces of lime	ectona fragmante	
vellowish brown	19				C15	V	1.40		<u>Clay:</u> silty, some fine sand, traces of lime yellowish brown.	stone tragments.	

Pro	ject:	~			4	لعيون	رى ا	مستشفى المغربي الخير BH-No.:	4 -
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Bor	ehole	Elev	atio	n:		N/A			/2/2000
Fina	al G.	W. D).:			N/A		Sheet: 2	2 of 2
Depth	San	nples	(N)	C c	ores	Str	rata	Description	Sector Station and American
(m)	No.	Туре	SPT	No.	Туре		Sec.		
_								Notes:	
21								- Attempts were made for core drilling at depths 4.0 - 5.0 m,	
22								11.0 - 12.0 m and 12.0 - 13.0 m with no core recovery. - High resistance for pushing Shelby tube from 4.0 m to 4.2 m.	
~~								 Shelby tube could not advance at depth 6.0 m to 7.0 m. 	
23_								- No return of the drilling fluid from 8.0 m to end of boring at 2	0.0 m.
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Annex 5: Water flow rate from an existing dewatering project in the area

Ahmad Kuhya Mosque is the only site in the study area with an installed dewatering system, the numbers below calculate the amount of water pumped per day from the site to be used as reference figures for the park.

Input Electrical Power (P)			
Voltage (V)	380	V	$W_{applied} = 3^{1/2} U I \cos \Phi$
Current (I)	15	А	$=3^{1/2} U I PF$ (1)
Power Factor (PF)	0.73		
Real Input Power (P)	7207	W	where
Output Fluid Power (P)			W _{applied} = real power (W, watts)
			U = voltage (V, volts)
System Effeciency (η)	0.7		I = current (A, amps)
Fluid Power (P)	5045	W	$PF = \cos \Phi = power factor (0.7 - 0.95)$
Density of Fluid (ρ)	1000	kg/m ³	$W_{out} = W_{in} \frac{\gamma}{100\%}$
Acceleration due to Gravity (g)	9.81	m/s ²	100%
Fluid Column Height (h)	5	m	
			$P_{\text{static fluid}} = \rho g h$
Pressure (P)	49050	N/m ²	
			where
Flow Rate (Q _{peak})	0.103	m³/s	
	103	l/s	$\rho = m/V = $ fluid density
			g = acceleration of gravity
Up time after 15 minute (900 second) pause	35	S	h = depth of fluid
Up time per day (86,400 seconds)	3234	s/day	Power = P × Q
Flow per day (Q _{average}) for 113 m of exposed soil	332650	l/day	Flow per day = Flow per second × seconds per day
Flow per day (Q _{average}) for 1 m of exposed soil	2940	l/day/m	 Can be used for estimating flow rate of other systems employing different "lengths" of exposed soil

Amounts of water pumped daily = 332 m3/day.

Area of site = 250 m^2 .

Length of pipes = 113 m.

Pipe Diameter = 6 inch.