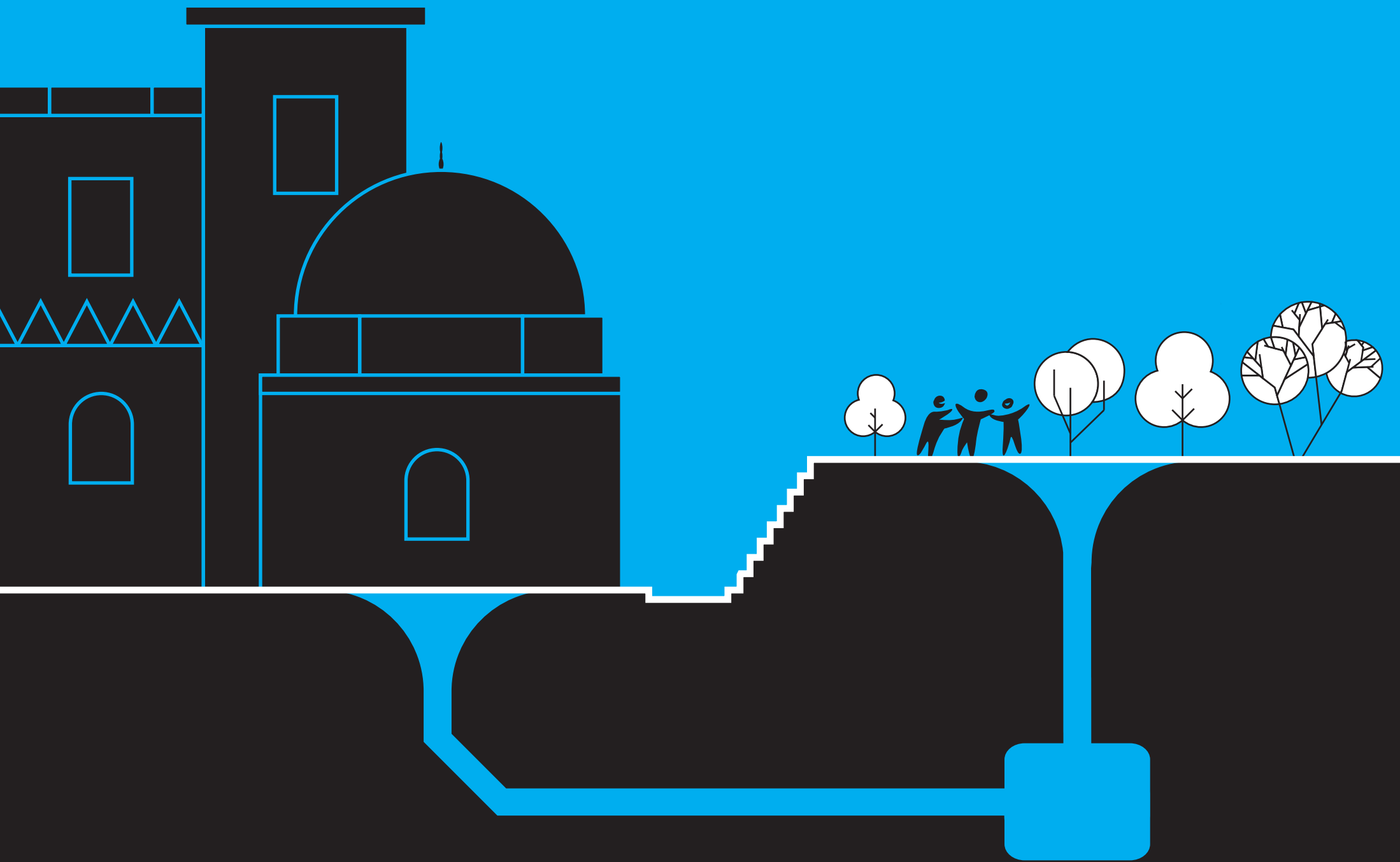


المشروع البحثي للمياه الأرضية  
GROUNDWATER RESEARCH PROJECT

# KHALIFA HERITAGE & ENVIRONMENT PARK

*Groundwater research  
project international school*

28 March 2017 - 06 April 2017



**ABOUT THE WORKSHOP**

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# ABOUT KHALIFA HERITAGE & ENVIRONMENT PARK

**MARCH –APRIL 2017**

## **1. General brief**

Khalifa Heritage and Environment Park project builds on the momentum of multiple, related initiatives in al-Khalifa neighborhood and focuses on a state-owned strip of empty land strategically situated at the southern gateway of al-Khalifa Street; a site that overlooks two critically important monuments. Cairo Governorate has begun work on this plot of land with a goal to convert a 400-sqm section into a playground, urban gardens, heritage and environment support center, and café, as well as the conversion of a staircase between Zaynhum housing project and al-Khalifa neighborhood into a ramp to allow improved circulation for persons of all abilities.

In light of the findings of the Conservation School organised by Athar Lina; as part of Khalifa Groundwater Research Project, the Governorate now wishes to expand and adjust the scope of this project to include a multi-functional environmental component to rehabilitate the entire area of the ridge. The project will direct groundwater and water from leaking supply pipes to the site as a resource that can be utilized to more effectively achieve environmental project goals. While traditional dewatering approaches involve routing collected water to the sewage system, thereby taxing an already overloaded system, this project will use this water to enhance public open space and realize other benefits.

The open space of the site, and its environs, presents environmental, safety and security hazards. At the same time, it is one of the neighborhood's most untapped resources since it has the potential to support critical services and provide much needed women/children friendly spaces. The project as is intended will become a replicable model for aligning goals of quality public open space and improved environmental function, as well as serving as a model for government/civil society interdisciplinary collaboration.

The full range of functional and aesthetic improvements associated with project implementation includes:

- Enhancing public open space in an underprivileged inner city neighborhood.
- Empowering women, children and youth.
- Fostering environmental sustainability and awareness.
- Conserving heritage and historic building stock.
- Creating jobs, alleviating poverty and enhancing economic vitality overall by celebrating important cultural heritage sites and thereby increasing tourism.
- Improving accessibility to quality open space for about 30,000 inhabitants of al-Khalifa and Zaynhum Housing Project, all within a 15 minute walking distance.
- Dropping the water table at al-Ashraf Khalil and Fatma Khatun Domes, and surrounding neighborhood resulting without overload sewage systems.
- Reducing the urban heat island effect.



## 2. Program and parameters

What follows is a listing of desired uses for the site. Although these are described separately, a major emphasis of the International School will be to establish synergies and interactions between them.

### a. Recreation Space

Recreation for families, particularly women, children and young teenagers of al-Khalifa. It will include women's sports, a children's playground, and seating areas (note that field studies have shown that these groups are the least served by public and open space. These uses will complement the project implemented in the area by Cairo Governorate that includes a football field).

### b. Urban Gardening Centre

- A micro-gardening area with facilities for training women and youth in urban gardening.
- A system to intercept groundwater that is causing damage to heritage sites.
- Planting of certain species of trees for reduction of subsurface water levels and for reduction of the heat island effect in the neighborhood.
- A place for small-scale environmental measures and for introducing participatory approaches through awareness and training.
- A permanent exhibition on heritage and environmental issues and concerns.

### 3. Schedule

International School Khalifa Heritage and Environment Park							
Days	Section	Subjects (9:00 am to 5:00 pm)		Instructors	Evening Sessions & Public Events	Notes	
1	Tue 28	Introduction	<ul style="list-style-type: none"> <li>• Site visit</li> <li>• Participant and instructor introductions</li> <li>• International School overview: project brief, schedule, and goals</li> </ul>	<ul style="list-style-type: none"> <li>• Presentations:                             <ul style="list-style-type: none"> <li>.Mohamed Sheta: Neighborhood water conditions</li> <li>. Meg Prier: Water design and engineering parameters &amp; principles</li> <li>. Brook Muller: Design narration/design integration</li> </ul> </li> <li>• Form teams and introduce optimisation assignment</li> </ul>	Brook Muller, Meg Prier, Mohammed Sheta, May al-Ibrashy, Ahmed Ebeid		Optimisation Assignment teams will engage in an in depth study and design of different program elements including: urban agriculture/north edge of park; women's space/play area; café/shops; stepped seating/retaining elements; exhibition and interpretation; water systems
2	Wed 29	Optimisation Phase	<ul style="list-style-type: none"> <li>• Presentation: Carsten Riechelmann: Water reuse projects</li> <li>• Optimisation team workday with check in presentations at day's end</li> </ul>		Brook Muller, Meg Prier, Carsten Riechelmann, Kareem Ibrahim, Ahmed Ebeid		
3	Thu 30		<ul style="list-style-type: none"> <li>• Optimisation team workday</li> </ul>				
4	Fri 31		<ul style="list-style-type: none"> <li>• Optimisation presentations</li> </ul>	<ul style="list-style-type: none"> <li>• Presentation: Joshua F. Cerra: Microclimate needs and benefits of urban landscape space</li> <li>• Introduce design integration assignment</li> </ul>	Brook Muller, Meg Prier, Kareem Ibrahim, Mohamed Sheta Ahmed Ebeid		Design integration assignment; the majority of teams will devise schematic design schemes for the site in its entirety; 1-2 teams will continue to work on water systems both for the site and as a possible prototype that can be utilized on other sites
5	Sat 1	Field Trip	Tour of Al-Azhar Park and other water-related historic sites		May al-Ibrashy	Evening public talk by Aniket Bhagwat: "Running on the Edge; Design from India" (6:00 pm to 9:00 pm)	
6	Sun 2	Design Integration Phase	<ul style="list-style-type: none"> <li>• Design integration team workday</li> <li>• Q&amp;A: Azhar Park VP, Mohammed Essawi</li> </ul>		Aniket Bhagwat, Joshua F. Cera, Brook Muller, Ahmed Ebeid	Community Meeting: Present initial ideas	
7	Mon 3		Design integration team workday				
8	Tue 4		<ul style="list-style-type: none"> <li>• Design integration team workday</li> <li>• Discussion: identify key project attributes</li> </ul>				
9	Wed 5		Design synthesis		Kareem Ibrahim, Joshua F. Cera, Brook Muller, Ahmed Ebeid	Evening public talk by Brook Muller: Blue Architecture (Hydro-Logical Design) (6:00 pm to 9:00 pm)	
10	Thu 6	Final Presentations	<ul style="list-style-type: none"> <li>• Design synthesis final presentations</li> <li>• Wrap up discussion</li> <li>• Awarding of certificates</li> </ul>		Joshua F. Cera, Brook Muller, May al-Ibrachy Representatives from Cairo Governorate & Ministry of Antiquities	Closing Dinner	

## 4. Instructors



### **Brook Muller**

Brook Muller, Professor of Architecture, Core Faculty member in Environmental Studies, and Director of the Graduate Certificate Program in Ecological Design at the University of Oregon.

Brook's research addresses ecologically responsive, systems oriented design, with an emphasis on synergies between sustainable architectures and climate adaptive urban landscapes. In 2009, Brook was awarded the Campus Compact Award for Civic Engagement in Sustainability. Brook is the author of *Ecology and the Architectural Imagination* (Routledge 2014). He also served as Interim Dean of University of Oregon's School of Architecture and Allied Arts from 2014-2016.

### **Joshua F. Cerra**

Joshua F. Cerra is an Assistant Professor and Director of Undergraduate Studies at Cornell University, Department of Landscape Architecture in Ithaca, New York.

Prior to joining Cornell, Cerra practiced as a designer and an ecologist on projects in the Pacific Northwest and China. His academic and professional work addresses relationships between urban ecosystems, communities and site development processes, and their implications for urban ecological design and climate adaptation. He was the recipient of the Cornell CALS Young Faculty Teaching Excellence Award in 2014 and the CELA Excellence in Design Studio Teaching Junior Level Award in 2015.



### **May al-Ibrashy**

May al-Ibrashy is founder and chair of the Built Environment Collective, an Egyptian NGO and director of Megawra, its commercial arm. She is coordinator of Athar Lina, a participatory initiative integrating conservation and community development based in Historic Cairo. In addition to her practical work as an architect with close to 25 years of experience in architectural conservation and documentation, she is adjunct lecturer of architecture at the American University in Cairo. She holds a BSc in architecture from Ain Shams University and a PhD and MA in art, architecture and archaeology from the School of Oriental and African Studies, the University of London.



### **Aniket Bhagwat**

Aniket Bhagwat runs a highly successful, design practice based out of Ahmedabad. A third-generation landscape designer, the firm has, over decades, established themselves as arguably the most lauded landscape design firm in the country; and by some accounts amongst the 50 firms in the world that explore and define the profession with a rare passion and vigor. Phaidon rates the firm's work amongst the top 250 projects over 600 years of global landscape history. The firm is now equally respected for its select architectural design portfolio and master planning works. [www.landscapeindia.net](http://www.landscapeindia.net).



### **Kareem Ibrahim**

Kareem Ibrahim is an Urban Development Consultant and co-founder of Takween Integrated Community Development. He has been working on a range of issues including sustainable architecture, participatory planning, affordable housing, public infrastructure, and urban revitalization throughout Egypt with a number of local and international organisations. He is one of the project leaders of TADAMUN. He is an architect and planner graduated from Cairo University in 1995. In 1997, he worked on the UNDP's Historic Cairo Rehabilitation Project. He has also worked for Aga Khan Cultural Services – Egypt between 1997 and 2010 as the Built Environment Coordinator of the Darb al-Ahmar Revitalization Project, one of Cairo's most ambitious urban revitalization programs.





### **Mohamed Sheta**

Dr. Sheta is a geotechnical Consultant obtained his PhD from university of western Ontario, (UWO), Canada in 1981. He is registered as a professional engineer in the province of Ontario, Canada and the Engineering Syndicate of Egypt. Dr Sheta joined (UWO) as a staff member from 1981-1985 after which he joined Ardaman and associate consulting office in Florida USA. He was transferred to manage the Egyptian American joint venture. Ardaman-Ace consulting Firm in Cairo Since 1985 up till present. As a Consultant and manager of Ardaman-Ace he has provided geotechnical consultation and supervised all projects carried out by Ardaman-ACE which include over 3000 major projects in Egypt and several other projects throughout the Middle East and Africa. Dr. Sheta is considered as one of the top geotechnical consultants in Egypt and the Middle East region. His experience covers the fields of underground structures such as the Great Cairo Metro, tunnels, bridges, water and wastewater projects, Roadways as well as traditional Commercial and Administrative buildings. Dr. Sheta has a wide experience in the field of geohydrology as he designed and supervised many dewatering project, such as the Presidential Palaces in Egypt, and many others.



### **Megan Prier**

Meg Prier, Project Manager & Designer with Hyphae Design Laboratory, has participated in a variety of projects around the world from sanitation in the slums of Uganda to passive desert architecture in Egypt and rain water harvesting in Tanzania and South Africa. Meg holds a bachelor's degree in civil and environmental engineering and master's degrees in design and urban planning for sustainable urban transitions. At Hyphae, Meg has managed a variety of projects from a composting toilet for the homeless in San Francisco to water reuse systems on affordable housing and the design of a human and environmental health center.



### **Ahmed Ebeid**

Ahmed Ebeid is a research scientist at the Magdi Yacoub Heart Foundation in Aswan, focusing on computational methods for analysing patient data. Prior to this role, he was on the engineering team of an oilfield products company designing drilling tools. Ahmed has a BSc. in Mechanical Engineering from the American University in Cairo and his research interests revolve around employing engineering and mathematical methods in sustainably solving everyday problems particularly relevant to developing countries.

## 5. About Athar Lina Groundwater Research Project

A multi-disciplinary research and training program with the participation of an international team of architects, conservation experts, planners and experts in urbanism, environment, infrastructure and water resources. The program is organised by Megawra- Built Environment Collective and Oregon and Cornell universities, with funding from the American Research Center in Egypt and the American Embassy in Cairo and in partnership with the Ministry of Antiquities and Cairo Governorate to:

- Study the phenomenon of ground and subsurface water rise in historic areas and its effect on historic buildings. (Research phases: Aug-Oct 2016 and Jan-Mar 2017)
- Train professionals and scholars in the field of heritage conservation on state of the art techniques of treatment of historic buildings suffering from salt and water damage. (Conservation School: Nov-Dec 2016)
- Organise an international school to develop integrated methodologies for the treatment of water extracted during dewatering processes to be used as an alternative for supply water for cleaning, industrial, irrigation or irrigation purposes. (International School: Mar-Apr 2017)
- Pilot one or more proposed methodologies in al-Khalifa. (Piloting and Intervention phase: May-Jul 2017)

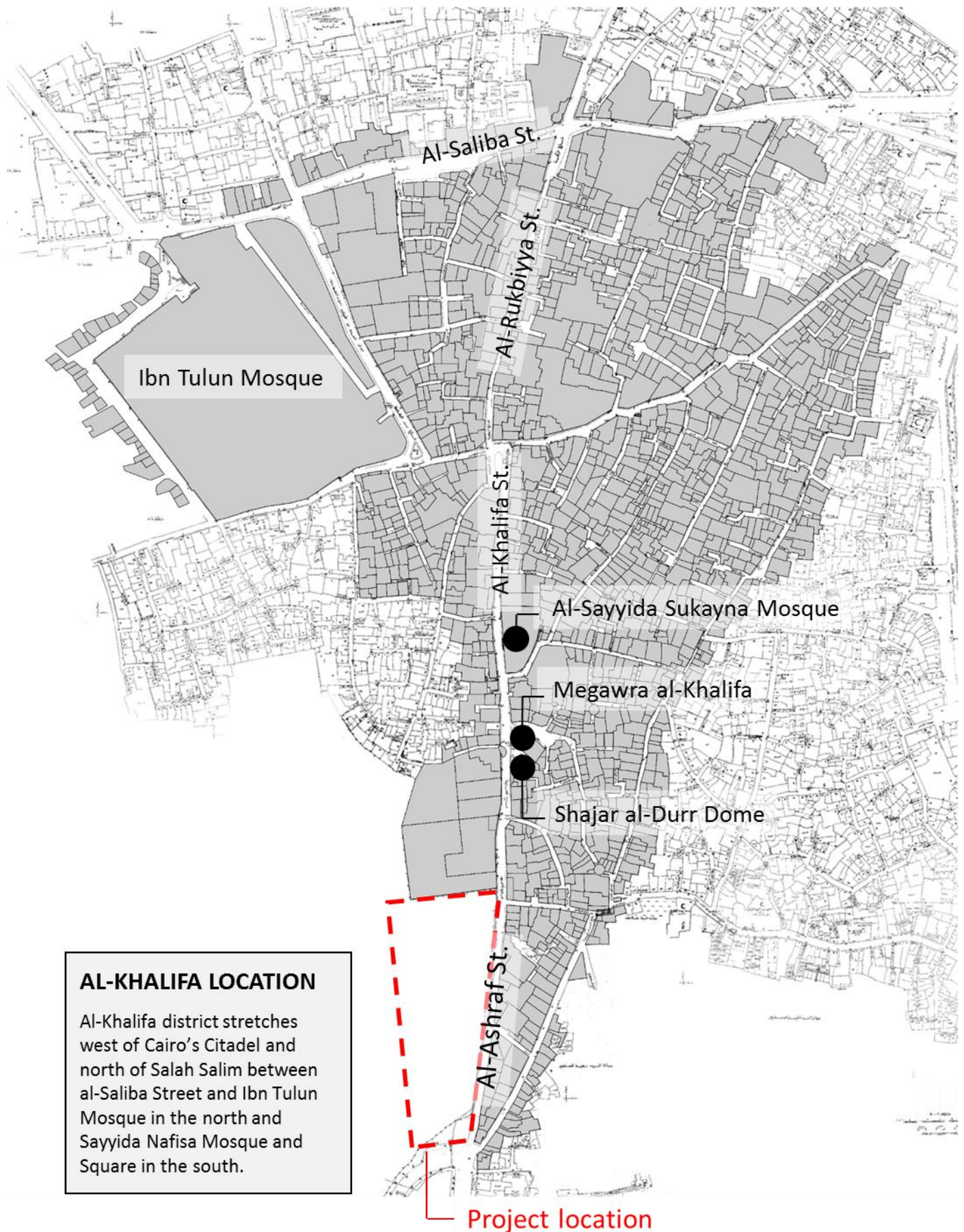
The program will follow a sustainable methodology through technologies that can be implemented and that are suitable for the social particularity and economic conditions of the area with the aim of transforming ground water from a source of harm to a social resource. It builds on Athar Lina Initiative's mandate to preserve the historic city and make sure it is used efficiently as a social resource and driver for development. Athar Lina initiative has been implementing an integrated participatory program of conservation, rehabilitation, heritage education, tourist development, capacity building and urban development in the neighborhood of Khalifa since 2012 based on this mandate.

**DETAILED BRIEF**



# DETAILED BRIEF

## 1. Project location



**AL-KHALIFA LOCATION**

Al-Khalifa district stretches west of Cairo's Citadel and north of Salah Salim between al-Saliba Street and Ibn Tulun Mosque in the north and Sayyida Nafisa Mosque and Square in the south.

## 2. Problem statement

This is a proposal for the rehabilitation of an elevated strip of open space – currently used as a garbage dump and for illicit activities - into a heritage and environment park primarily for the use of the residents of a historic Cairene neighborhood. The area is therefore the site of coordinated efforts between different governmental entities, civil society yielding results with a positive impact on the quality of life in an underprivileged neighborhood within a participatory framework of integrated development.



*Al-Khalifa Ridge*

The design process should build on the momentum of these efforts and attempts to focus them on a state-owned 3000 m<sup>2</sup> strip of empty land strategically situated at the southern gateway of al-Khalifa Street with a 150 m street front and overlooking to important 14<sup>th</sup> century Mamluk domes, al-Ashraf Khalil and Fatima Khatun. As mentioned above, the plot as it stands represents a hazard to the community for the following reasons:

- It is a garbage dump and as such a health hazard.
- Its uninviting appearance is a deterrent to current religious tourism and potential cultural tourism.
- Its abandoned state renders it an ideal location for illicit drug use and as such, it is a security hazard this despite it being the main access point between al-Khalifa and Zaynhum Housing Estate.

Its potential lies in the following:

- As the biggest state-owned plot, well located in a relatively public area, it can function as a much needed space for families, particularly women and children, and as a green lung in the neighborhood.
- As a node for heritage awareness and magnet for tourism that should ideally flow from south – where al-Sayyida Nafisa shrine and historic cemetery are located- northwards to the shrines of descendants of the prophet and architectural jewels such as Shajar al-Durr dome.
- As a better connector between al-Khalifa and Zaynhum with easy access for special needs and carts.
- As a water catchment system that lowers groundwater currently, harming heritage sites and housing stock and uses it for irrigation and cleaning.
- As a local center for environmental awareness, teaching residents (particularly women and children) about issues of water conservation and urban gardening.



- As a job creator with the 150 m elevated street front ideal for shops and for a touristic café, that overlooks the historic domes of al-Ashraf Khalil and Fatima Khatun.
- As a model for successful partnership between government and civil society within an integrated participatory framework.

### 3. Current condition



*The existing paths link the project location to the context (al-Khalifa and Zaynhum).*

### 4. Proposed project

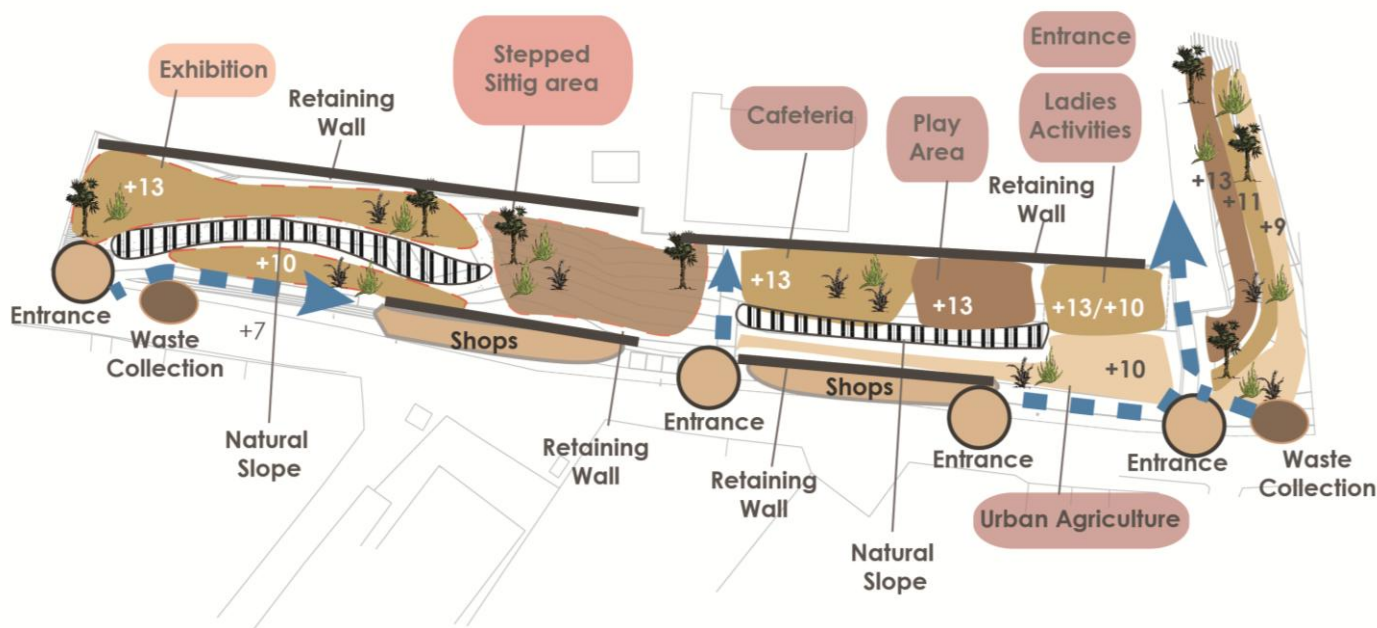
- A place for recreation for families, particularly women, children and young teenagers of al-Khalifa – to include seating areas, a place for women’s sports and a children’s playground. Studies have shown that this group is the least served where public and open space is concerned. Furthermore, this is to balance the project implemented by the Governorate, which contains a football field and will therefore be more youth and male oriented.

- A magnet for local tourism pulling visitors from al-Sayyida Nafisa (it contains Cairo’s most important shrine and is a place for pop-up coffee shops in the evenings) to the street, thus ensuring that the people of the neighborhood benefit from tourism and it spreads north to other shrines. The park will therefore include information signs and material about al-Khalifa’s tangible and intangible heritage and heritage activities for families and children (both resident and visiting) organised by Megawra-Built Environment Collective.
- A place for small scale environmental measures and for introducing environmental approaches through awareness and training. These recommendations are the result of the collaborative research efforts carried out in the last year and will be developed further in the international school. These measures include:
  - a. Micro-gardening area with facilities for training women and children in urban gardening.
  - b. System for partial lowering and partial treatment of subsurface water (flowing west to east and from highland to lowland) to use for irrigation and cleaning in the park and its surroundings. This will also reduce the amount of water reaching the eastern section of the street thus slowing down the damage it is doing to the 13th century domes there and adjacent houses. It will also reduce the load on the water supply and sewerage systems thus reducing the Carbon footprint of the area.
  - c. Planting of certain species of trees for reduction of the level of subsurface water and also to reduce the heat island effect in the neighborhood.
  - d. A permanent exhibition on environmental issues and concerns.
  - e. An efficient and sanitary waste collection system servicing the southern section of the street
- A place of connection with a special needs accessibility ramp between two communities that were previously one. The park lies between the historic community of al-Khalifa and the modern housing development of Zaynhum whose residents used to be part of al-Khalifa only to be disconnected from it spatially, economically and socially with the construction of the social housing.
- A source of livelihood for the people of al-Khalifa who will be given priority to operate the cafeteria, coffee shop and 10 shops that will be included in the project. The revenue from these spaces will go to the maintenance and financial sustainability of the project.

## 5. Project objectives

- Transform a 3000 square meter dilapidated plot located at the southern gateway of a historic neighborhood in Cairo into an environmental park with recreational facilities for residents and a heritage and environmental awareness focus.
- Enhance tourist and special needs accessibility to the street and the park.
- Lower the groundwater table currently damaging heritage sites and housing stock while treating and reusing the extracted water.
- Develop a replicable model for partnerships between the government and civil society within an integrated participatory framework.

## 6. Space program



The park should function as a connector between two neighborhoods and as an urban magnet that pulls tourism into the street also for the benefit of the community. The park's cafes and shops will generate jobs and water used for irrigation and cleaning will be harvested through a groundwater lowering system.

This system will also decrease the hazardous effect of water and salt damage on the neighborhood's heritage sites and housing stock. This will be achieved by including the following spaces and zones in the design:

Space	Description	Area
Gardening area	Micro-gardening area with facilities for training women and children in urban gardening	300 – 400 m <sup>2</sup>
Women's space	Closed gym for women	100 – 150 m <sup>2</sup>
Children's playground	Recreational area for children and seating areas for parents	400 – 500 m <sup>2</sup>
Heritage view cafes	Seating area and cafeteria with view of heritage site	400 – 500 m <sup>2</sup>
Shops	10 shops on street level	60 m <sup>2</sup>
Exhibition	A permanent exhibition on environmental issues and concerns	400 – 500 m <sup>2</sup>
Waste collection points	2 waste collection rooms	150 m <sup>2</sup> × 2 = 300 m <sup>2</sup>
Green buffer zone	Heavy greenery area above and below to purify air	400 m <sup>2</sup>

# PROJECT SITE ANALYSIS & DRAWINGS



# PROJECT SITE DRAWINGS AND ANALYSIS

## 1. Site analysis:

### a. Site circulation:



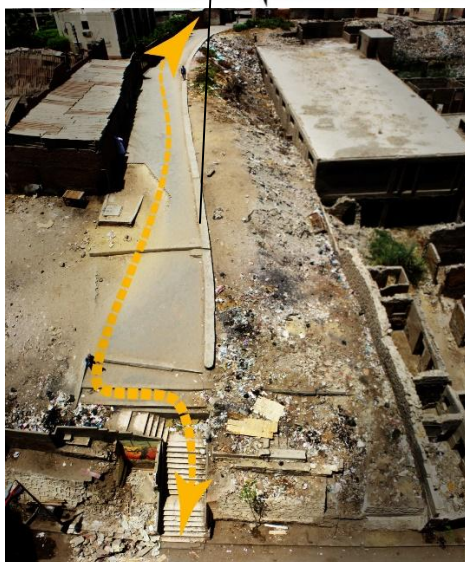
Parking zone



Al-Baqli St. – Commercial and recreational activities



Hawaii – Ice cream factory loading vans



The path from al-Ashraf St. to Zaynhum district



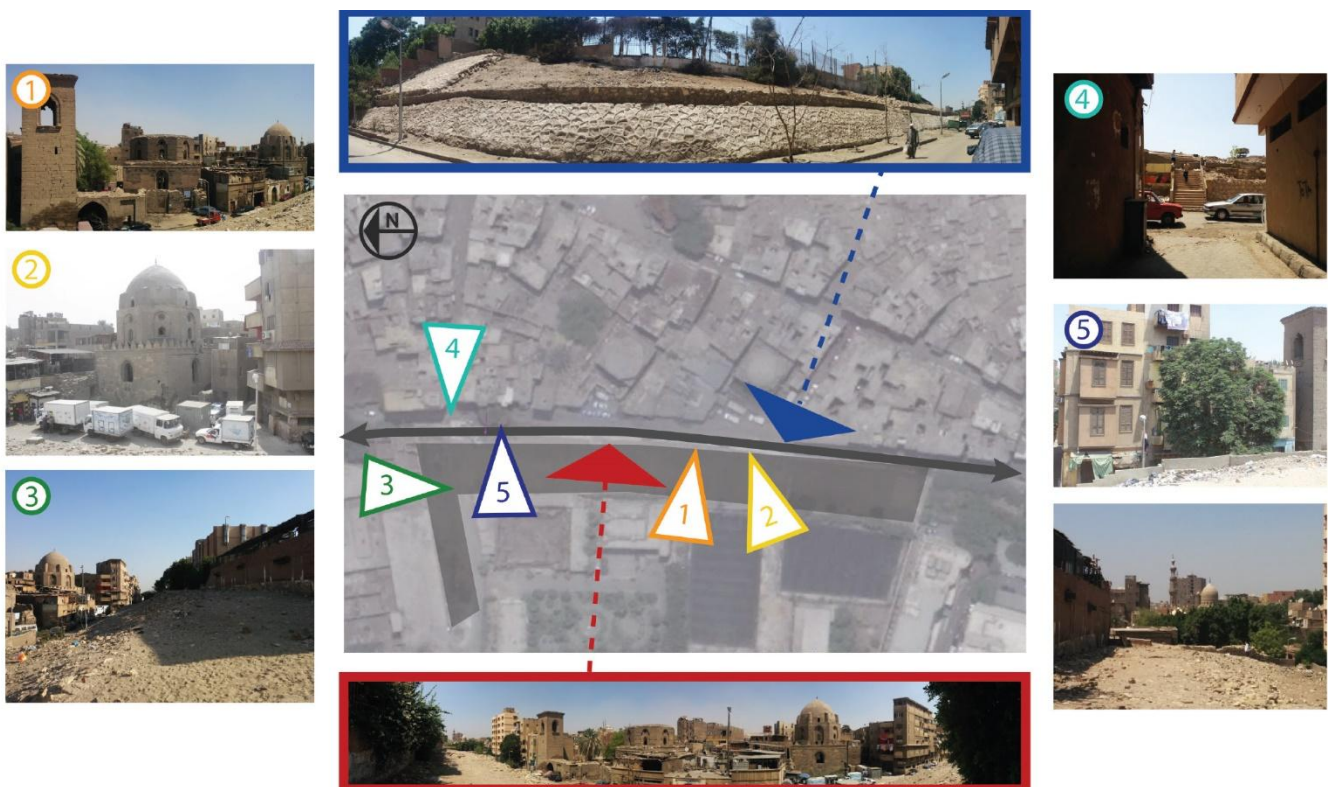
Cars parking on both sides of the street



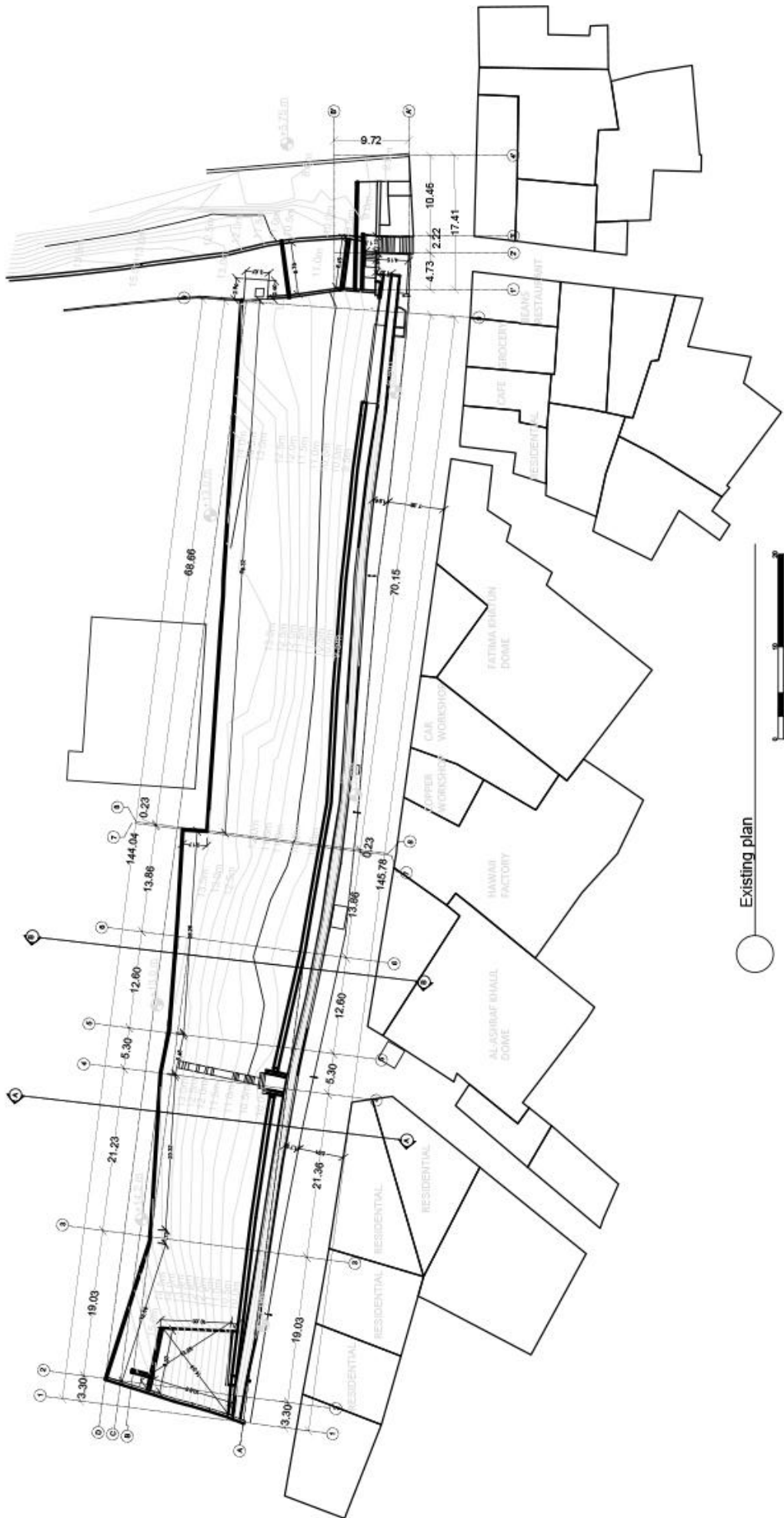
b. Surrounding activities:



c. Site views and vistas:



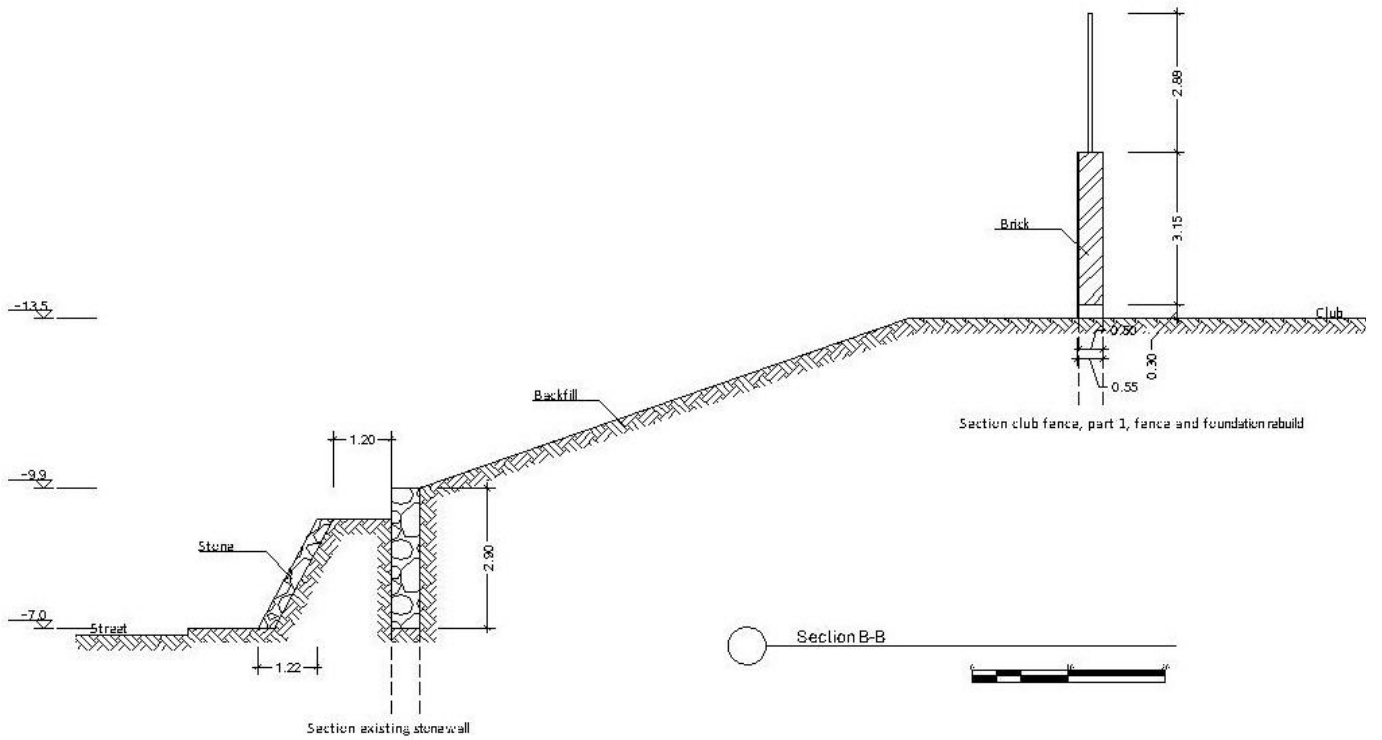
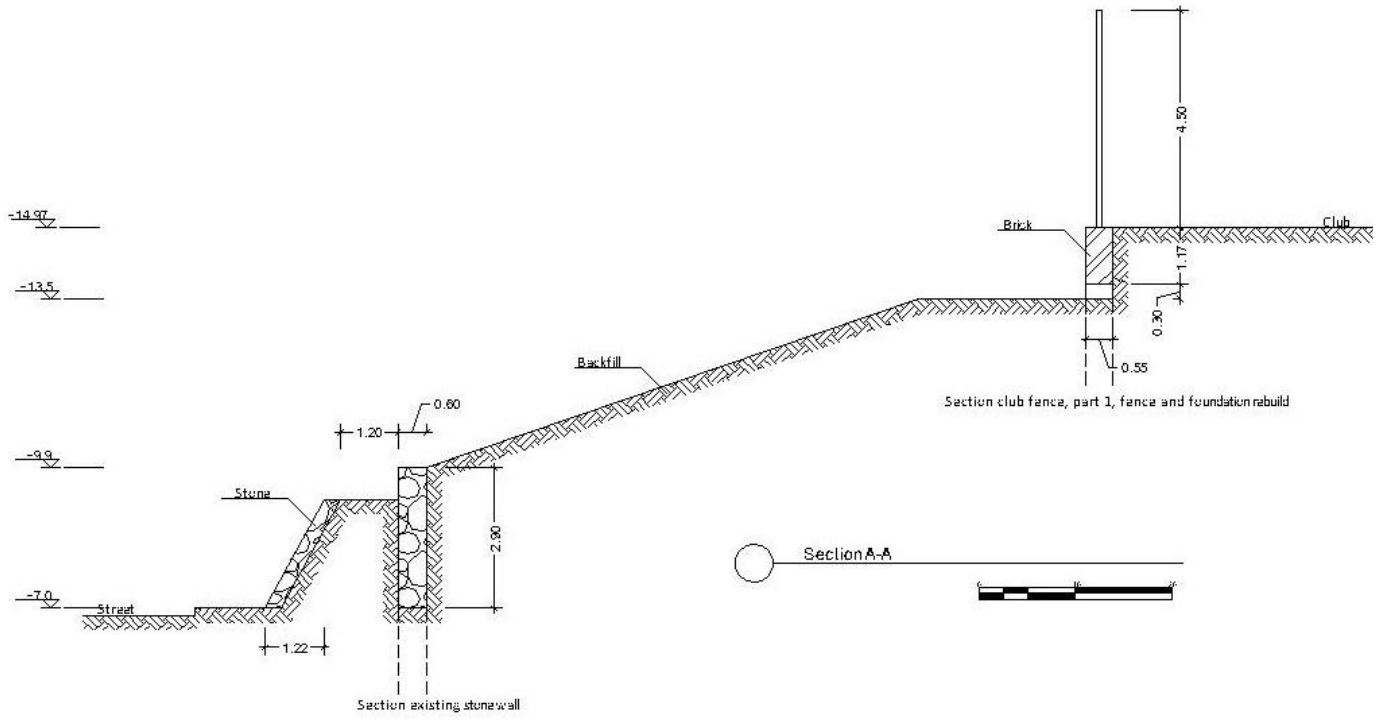




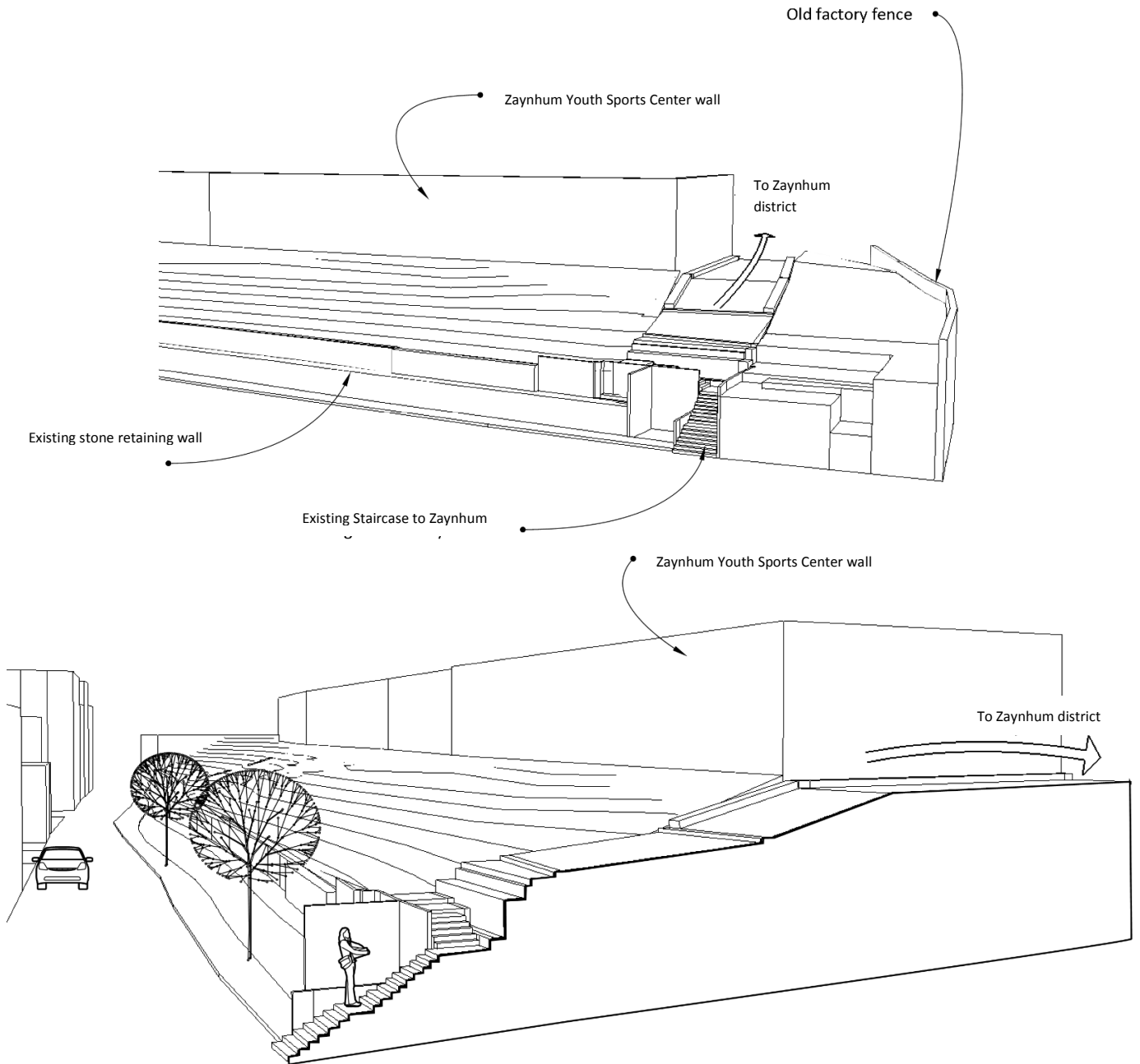
Existing plan

Plan – current condition

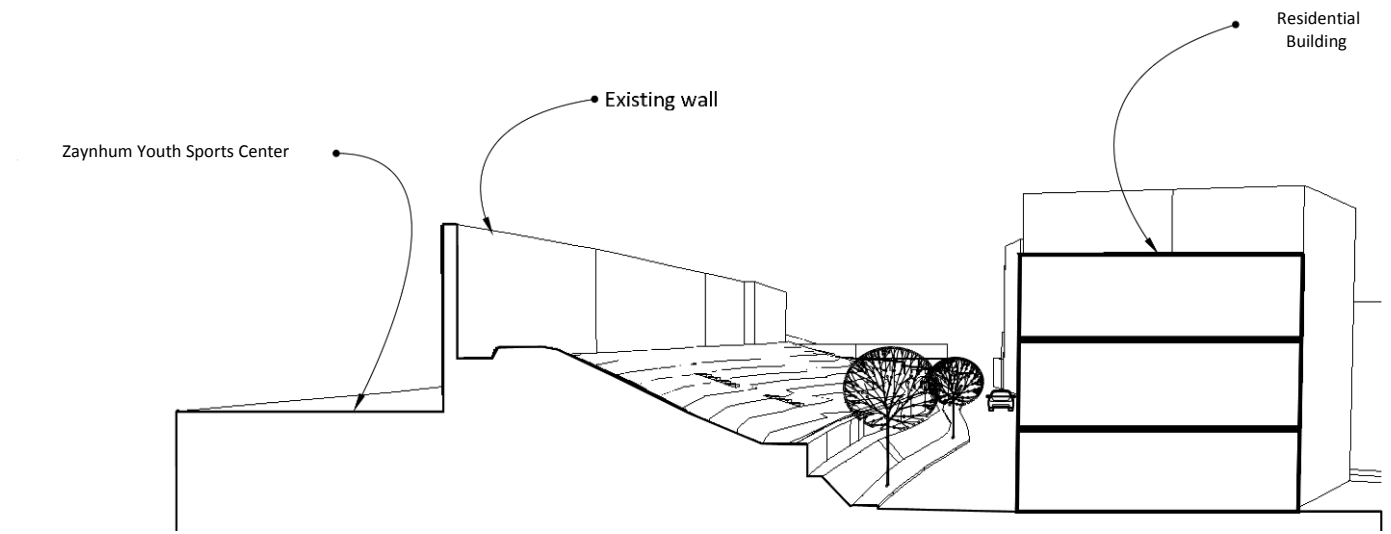




Sections – current conditions



*Current condition – steps to Zaynhum (south)*

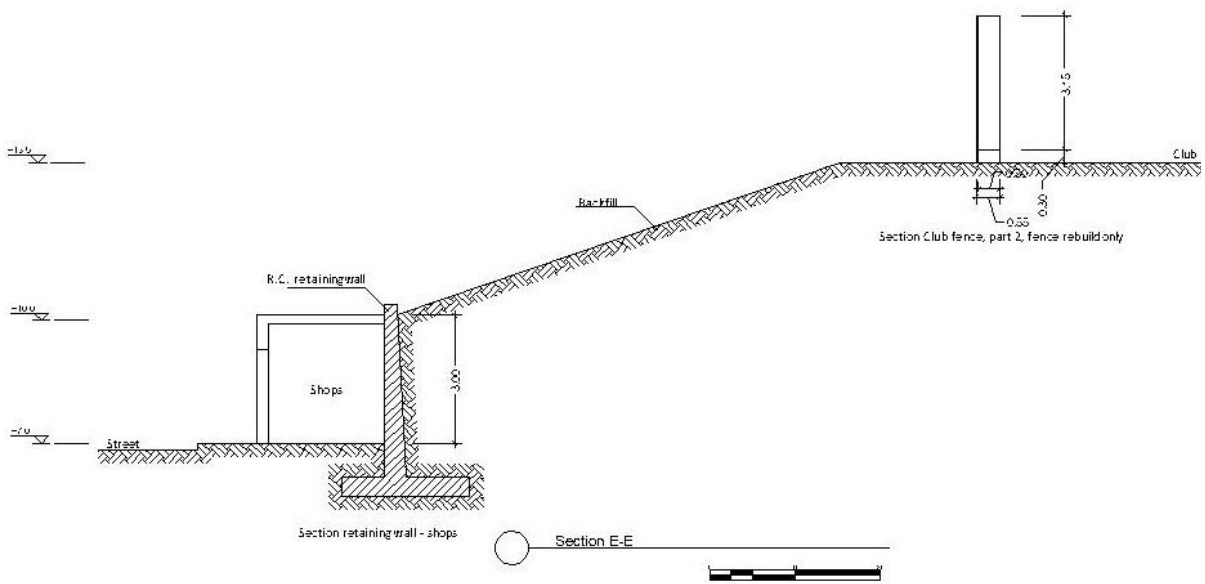
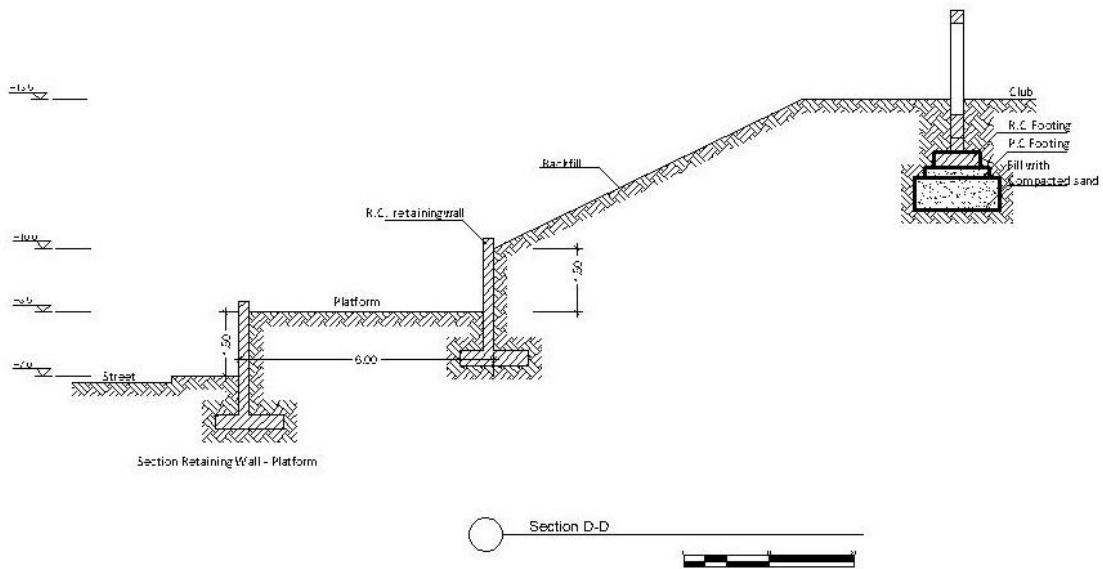
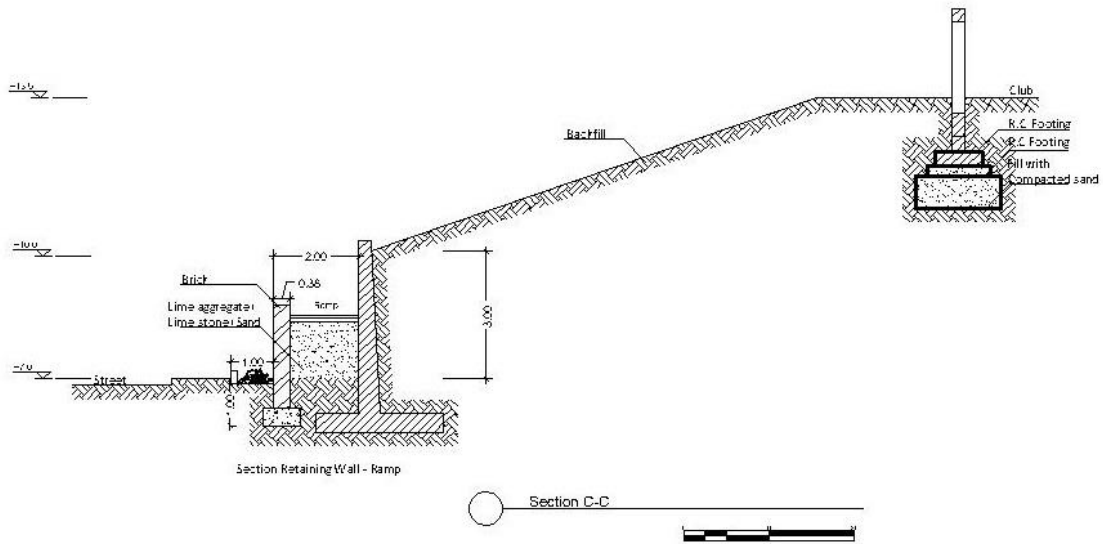


*Current condition – site cross-section*

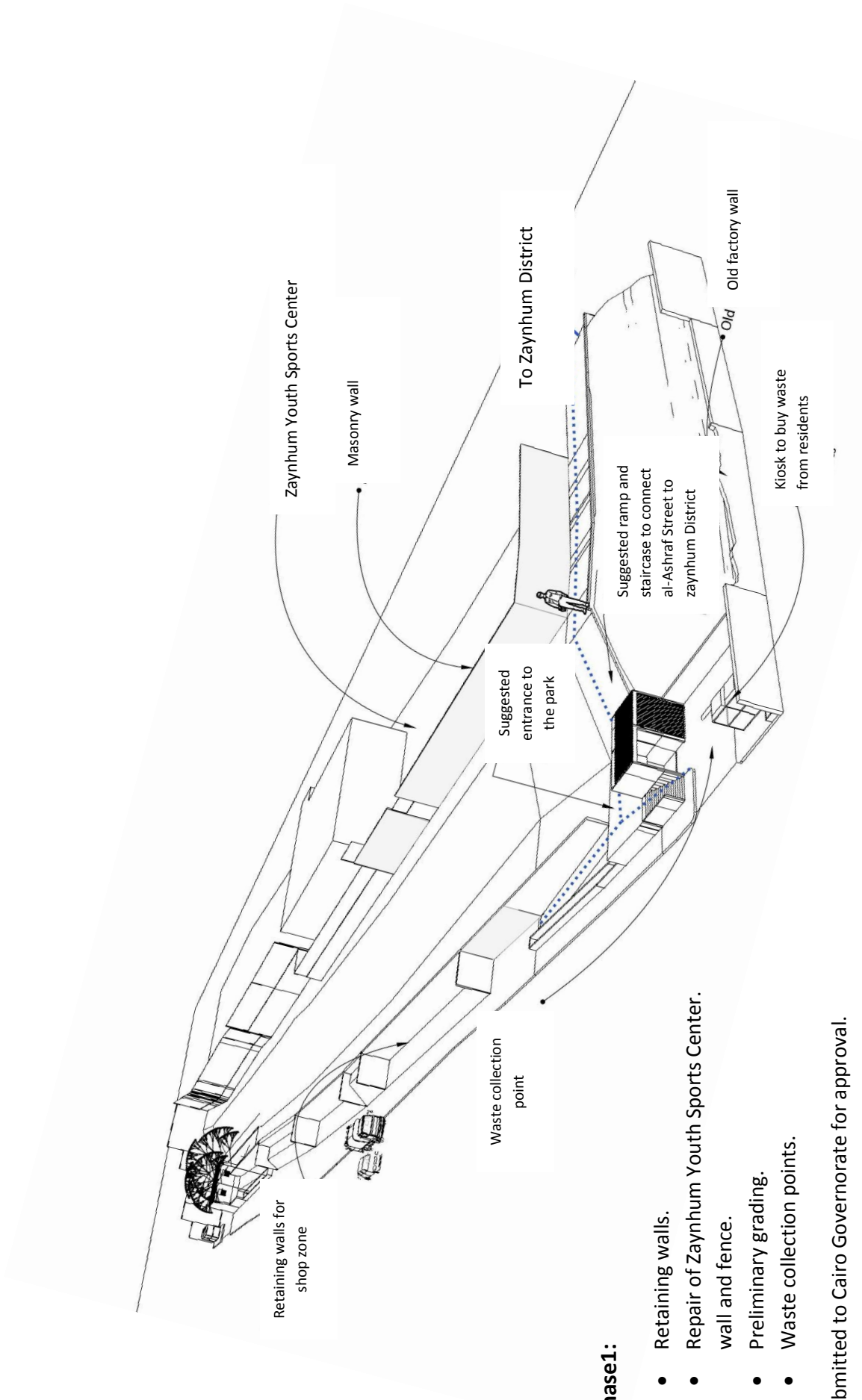
### 3. Proposed design drawings – Phase 1



Plan – phase 1



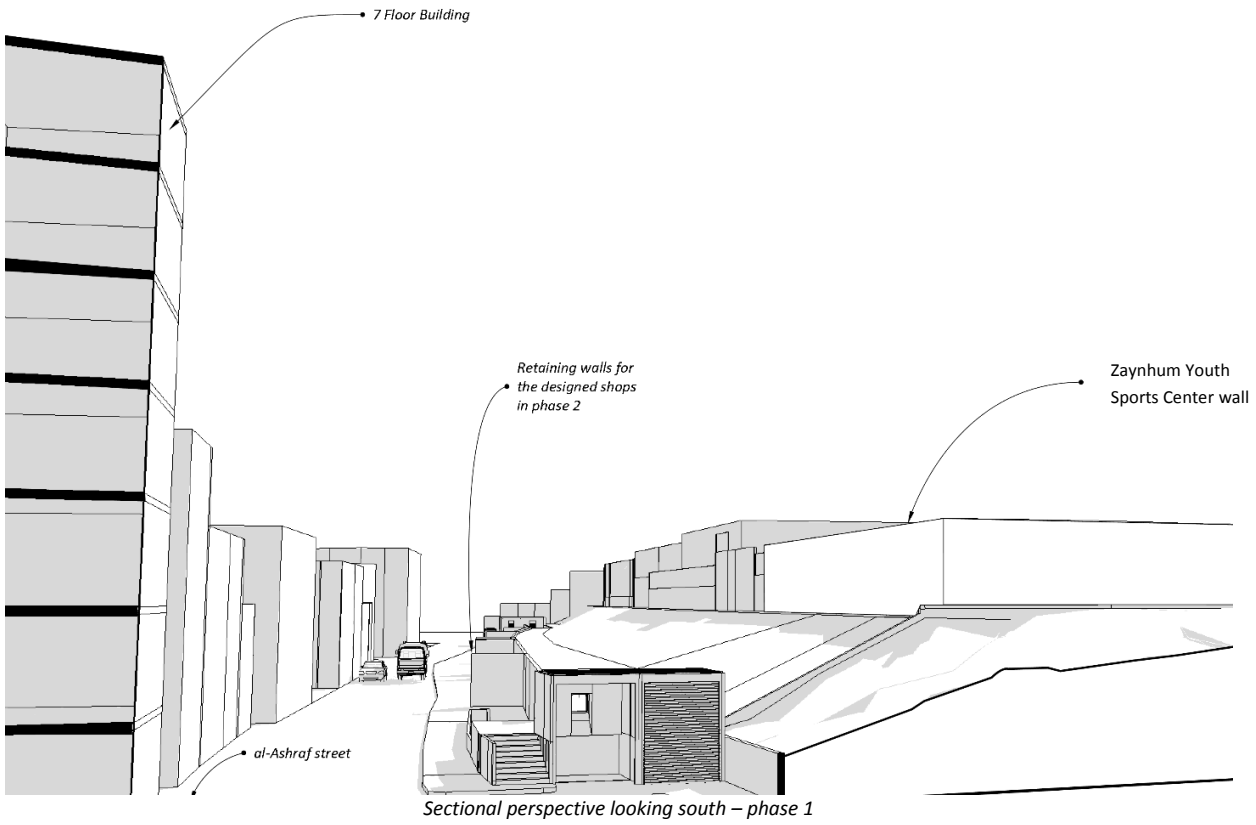
Sections - phase 1



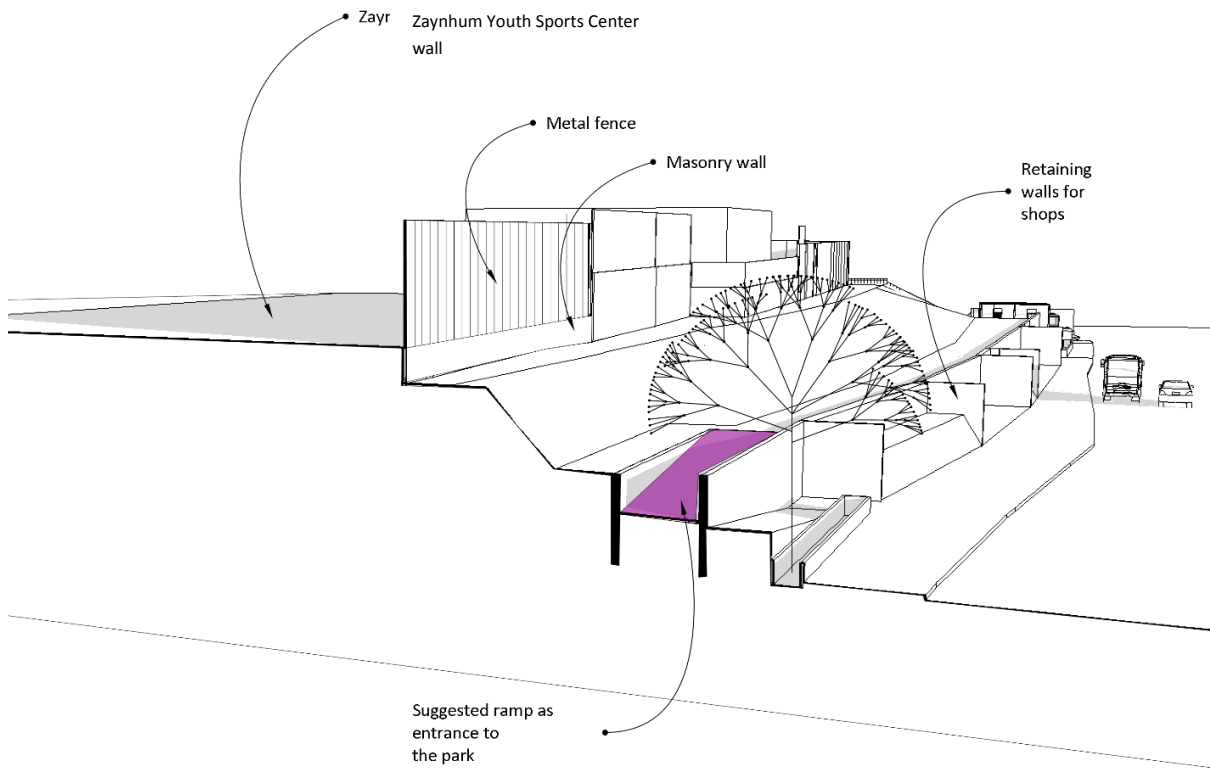
**Phase1:**

- Retaining walls.
- Repair of Zaynhum Youth Sports Center. wall and fence.
- Preliminary grading.
- Waste collection points.

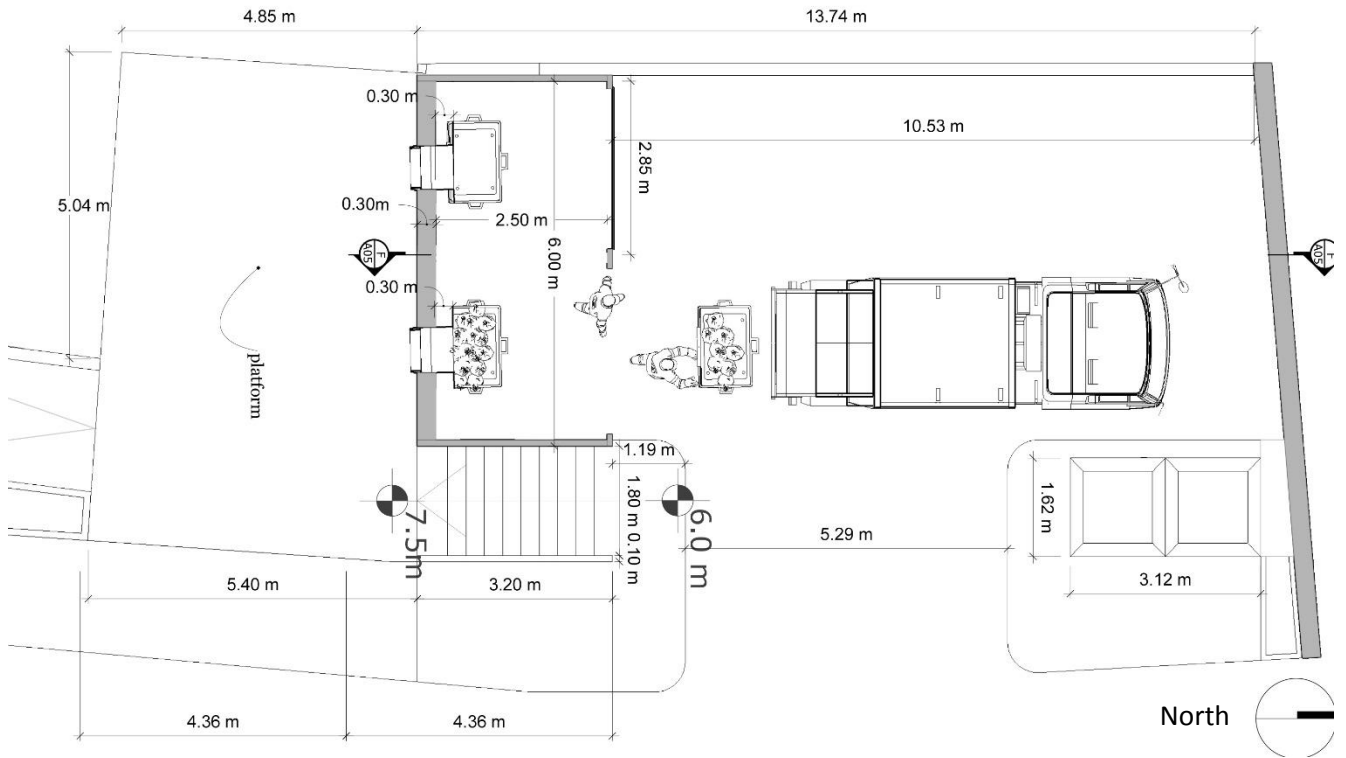
Submitted to Cairo Governorate for approval.



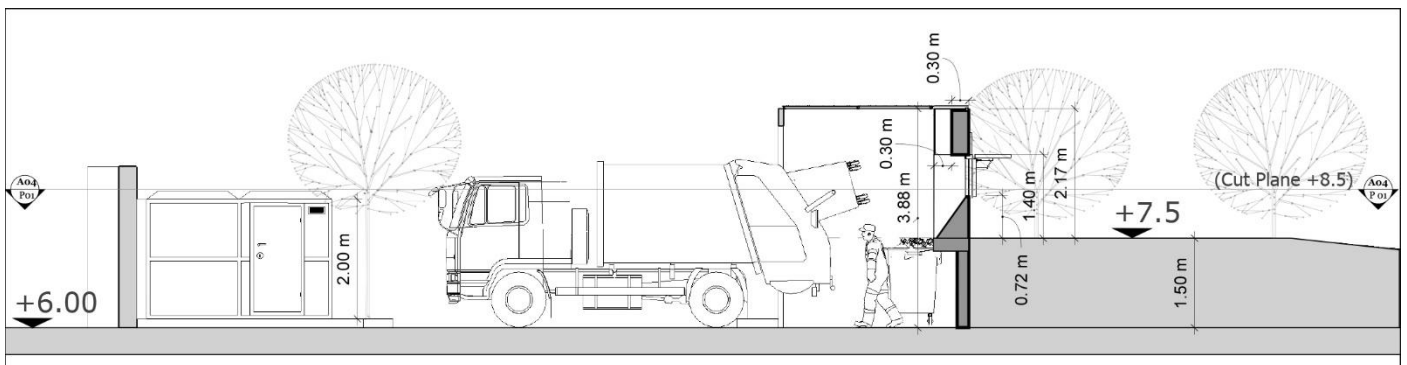
Sectional perspective looking south – phase 1



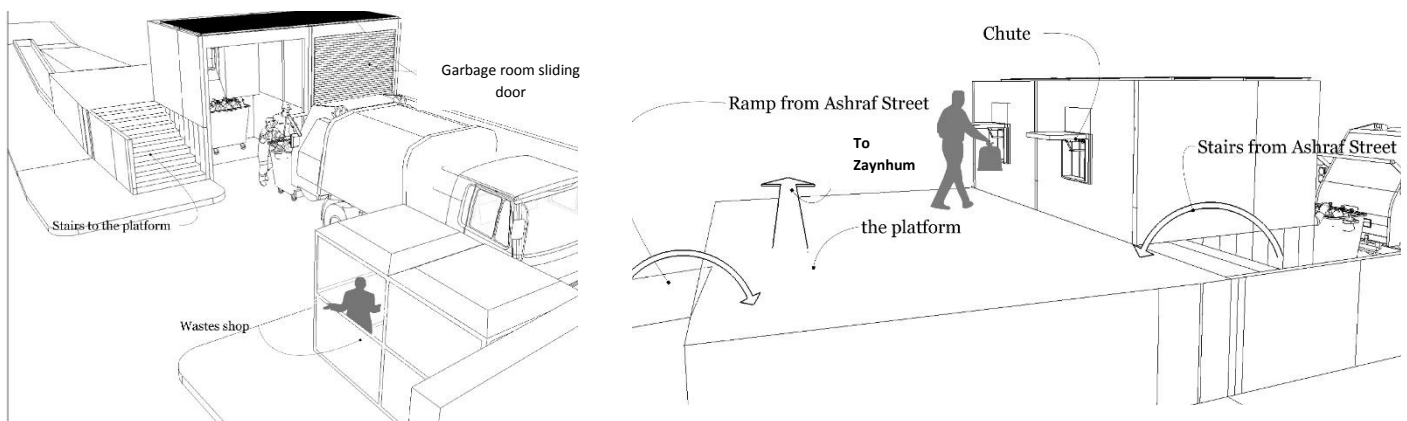
Sectional perspective looking north – phase 1



Plan - Waste collection point – phase 1



Section - Waste collection point – phase 1



Perspective shots - Waste collection point

# SUMMARY OF GROUNDWATER PROBLEMS



## SUMMARY OF GROUNDWATER ISSUES

This section contains information regarding groundwater specific to al-Ashraf Khalil Ridge site. For more information regarding groundwater in the whole study area; check the report *Detailed account of studies related groundwater in al-Khalifa* on the school website ([www.gwrpkhalifa.com](http://www.gwrpkhalifa.com)). Below are the most relevant sites with water problems followed by conclusions related to the Khalifa Heritage and Environment Park site.

### 1. Groundwater problems in al-Khalifa

Ground Water inundation appears in several places along al-Khalifa Street (12 spotted). Rising damp resulting from ground water poses a threat to many other buildings. This is due to the street's 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 opposite the site for Khalifa Heritage and Environment Park and suffer from rising damp, cracks as well as ground water overflow appearing in their surroundings.
- The street level in front of the Fatima Khatun monument is +876 cm, water level in the pisometer ranges from +586 cm to +626cm, and the level of the monument is +546 cm (zero = al-Saliba Street).



#### 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 (local problem in 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. Ruggaya 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. Ahmad Kuhya 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.
- Street level next to the mosque is -10 cm, water level in the case of absence of a dewatering system is -188 cm and with the system is -455 cm, and the monument ground level is +225 cm (zero = al-Saliba Street).



d. Deserted factory:

- Next to S. Ruqqaya Dome and neighboring Zaynhum has water appearing with water level higher than street level.
- Street level next to the deserted factory is +869 cm and the water appearing on site +546 cm (zero = al-Saliba Street).

## 2. Groundwater problems in Zaynhum

The public housing area, which was built on a hill higher than neighboring areas, was built in different phases through the 80s and the 90s. At least two buildings in the project were demolished due to structural problems caused by groundwater problems. 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 have been 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.

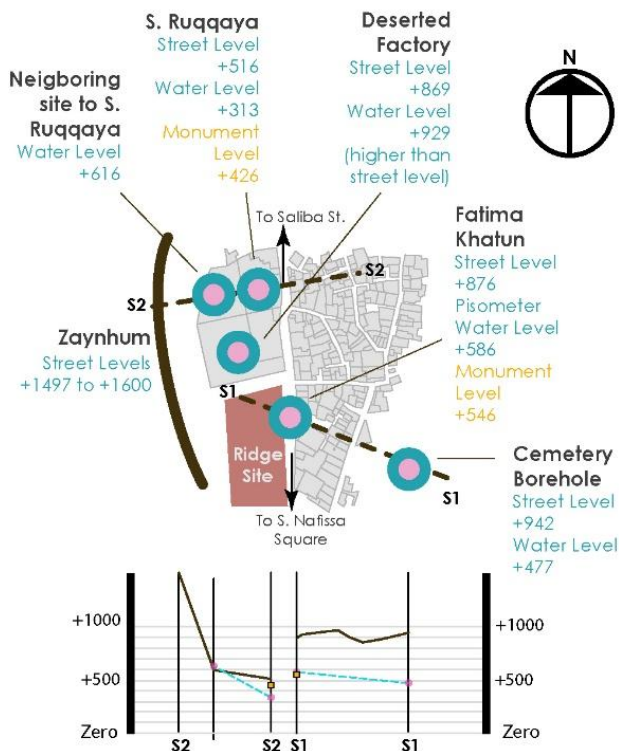




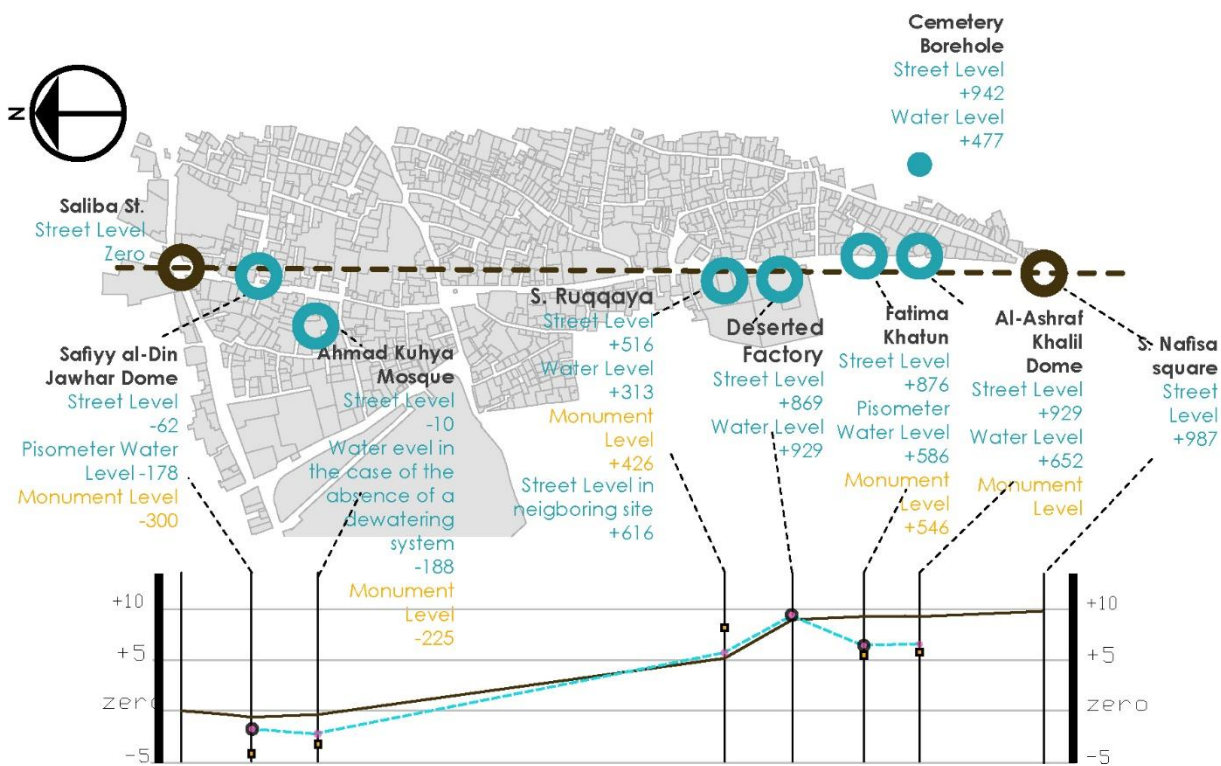


### 3. Water levels

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 around Khalifa Heritage and Environment Park



Levels of water in sites along Khalifa Street

#### 4. Water Analysis

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.

Chemical Test	WHO (ppm)	wastewater (mg/L-1)	Fatima Khatun		Safiyy al-Din Jawhar	
			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 <sup>-1</sup> (chloride)	-	100	951.4	mg/l	142	mg/l
NH <sub>4</sub> <sup>+</sup> (Ammonia)	1.5	12.0-80	1.2	mg/l	0.9	mg/l
NO <sub>3</sub> <sup>-1</sup> (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
  
2. 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 are directly proportional with chlorine values, and chlorine is the most common method for water treatment for drinking purposes.

## 5. Water quantities

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	$W_{\text{applied}} = 3^{1/2} U I \cos \Phi$ $= 3^{1/2} U I PF \quad (1)$
Current (I)	15	A	
Power Factor (PF)	0.73		
Real Input Power (P)	7207	W	
Output Fluid Power (P)			where
System Efficiency ( $\eta$ )	0.7		$W_{\text{applied}} = \text{real power (W, watts)}$
Fluid Power (P)	5045	W	U = voltage (V, volts) I = current (A, amps) PF = $\cos \Phi$ = power factor (0.7 - 0.95)
Density of Fluid ( $\rho$ )	1000	kg/m <sup>3</sup>	$W_{\text{out}} = W_{\text{in}} \frac{\eta}{100\%}$
Acceleration due to Gravity (g)	9.81	m/s <sup>2</sup>	
Fluid Column Height (h)	5	m	
Pressure (P)	49050	N/m <sup>2</sup>	$P_{\text{static fluid}} = \rho gh$
Flow Rate ( $Q_{\text{peak}}$ )	0.103	m <sup>3</sup> /s	where
	103	l/s	$\rho = m/V$ = fluid density g = acceleration of gravity h = depth of fluid
Up time after 15 minute (900 second) pause	35	s	
Up time per day (86,400 seconds)	3234	s/day	$\text{Power} = P \times Q$
Flow per day ( $Q_{\text{average}}$ ) for 113 m of exposed soil	332650	l/day	$\text{Flow per day} = \text{Flow per second} \times \text{seconds per day}$
Flow per day ( $Q_{\text{average}}$ ) for 1 m of exposed soil	2940	l/day/m	<ul style="list-style-type: none"> <li>• Can be used for estimating flow rate of other systems employing different "lengths" of exposed soil</li> </ul>

Amounts of water pumped daily = 332 m<sup>3</sup>/day.

Area of site = 250 m<sup>2</sup>.

Length of pipes = 113 m.

Pipe Diameter = 6 inch.



NEEDS ASSESSMENT

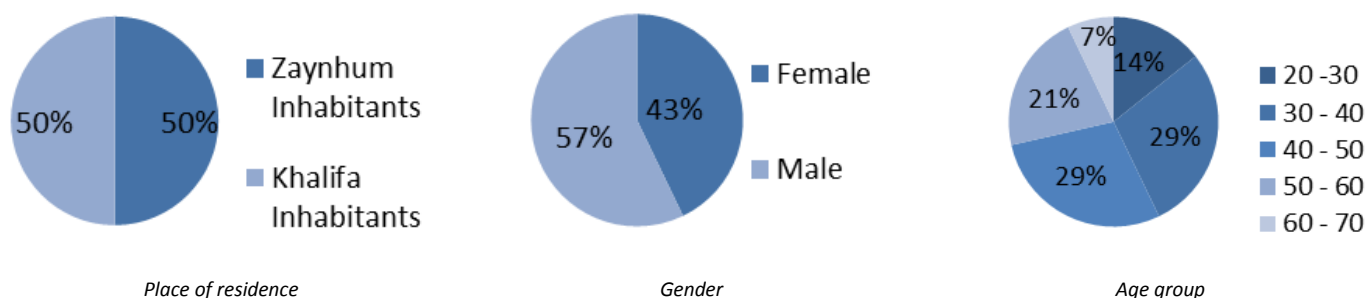
# NEEDS ASSESSMENT

## 1. Aim of survey

- Determining the problems of the ridge that face the inhabitants of Zaynhum and al-Khalifa areas and the suggested solutions for these problems.
- Determining the recreational places around the area of study especially those preferable to the inhabitants and the suitability of these places to the women and children living in the study area.
- Determining the water problems and uses in the study area and the suggested solutions for reusing treated water if the project was implemented.
- Taking people’s opinion on agriculture and their ability in participating in the plantation process.
- Determining garbage problems in the area and the suggested solutions for this problem, while taking the people’s opinion on the garbage recycling project.

## 2. Basic information about survey sample

The survey sample consisted of men and women ranging from 22 years old to 63 years old. A random sample was taken in area around the ridge, both in Zaynhum and al-Khalifa. The following charts represent the basic information about the survey sample including the percentages of the age groups, gender distribution and the living area.



### 3. Problems and solutions for al-Khalifa Ridge



#### Opinions of Zaynhum's inhabitants

**Problems:**

- Garbage
- Youth Gatherings
- Drugs
- Harassments
- Insecurity
- Insecurity for girls
- Darkness
- Dogs
- Animals
- Robbery

**Proposed solutions:**

- Lighting
- Project for youth
- Separation wall between ridge and housing areas
- Swimming pool
- Public Park
- Cafeteria
- Sewing workshop
- Activities for girls
- Shops
- Association or school

#### Opinions of al-Khalifa's inhabitants

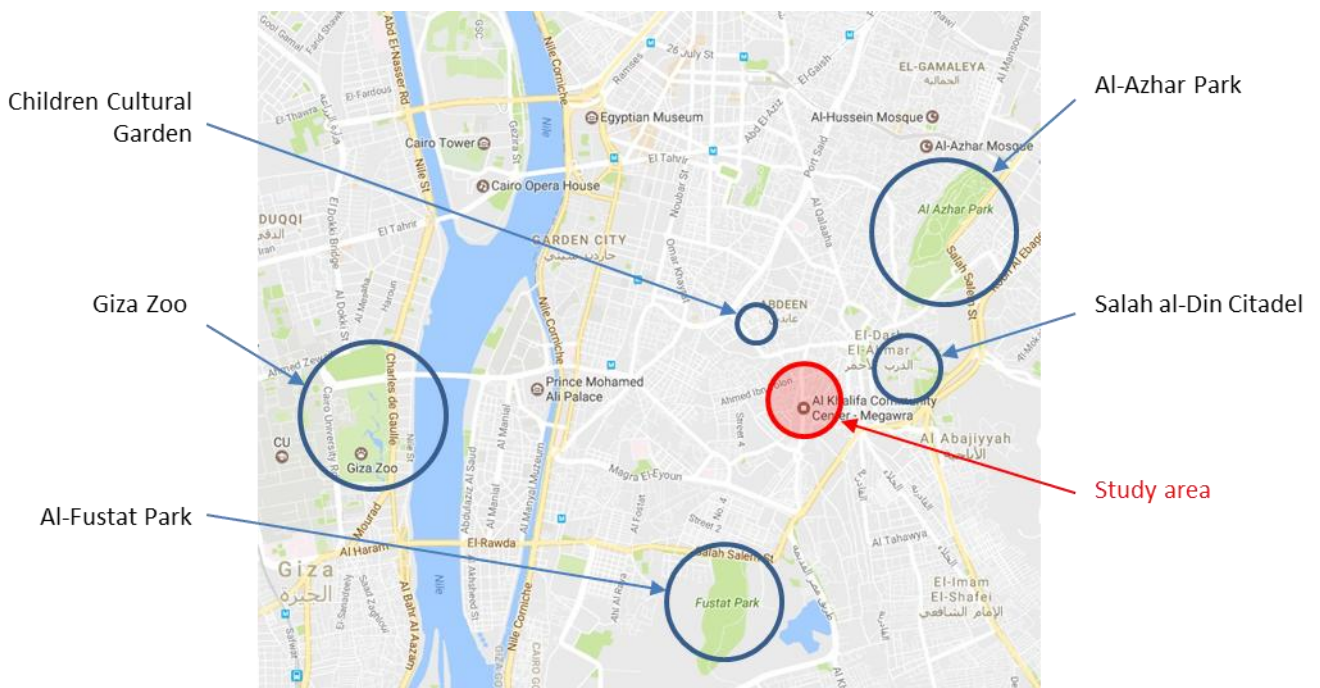
**Problems:**

- Garbage
- Youth Gatherings
- Drugs
- Darkness
- Dogs
- Insects
- Dust
- Bad view

**Proposed solutions:**

- Public Park
- Shops
- Markets and workshops
- Mini Industries
- Agriculture

#### 4. Recreational places (advantages and suitability for women and children)



Entertainment places around the area

##### Opinions of Zaynhum's inhabitants

###### Entertainment places around the area:

- Al-Azhar Park
- Al-Fuṣṭaṭ Park
- Giza Zoo
- In front of houses
- Fishing on the Nile
- Ṣalah al-Din Citadel
- Dar al-'Ulum Park

###### Advantages and suitability for women and children:

Most of the inhabitants confirmed that these places are suitable for women and children. The advantages of these places:

- Secure
- Children playgrounds
- Beautiful scene
- Family gathering

##### Opinions of al-Khalifa's inhabitants

###### Entertainment places around the area:

- Al-Azhar Park
- Al-Husayn
- Al-Manshiyya Park
- Children Cultural Garden
- Dar al-'Ulum Park
- Sports Club

###### Advantages and suitability for women and children:

Most of the inhabitants confirmed that these places are suitable for women and children. The advantages of these places:

- Suitable seating areas
- Children playgrounds
- Entertainment activities

## 5. Water (problems and uses)



### Opinions of Zaynhum's inhabitants

#### Water problems:

- Low Pressure
- Cut off
- Leakage in Sewage
- Dampness & Patches
- Depression in floor level
- Plumbing

#### Water usage:

- Daily usage
- Shops Usage

#### In case of fire:

- From the houses
- Public fire hydrant (Used in the past)
- Fire Engine

#### Suggestion for reusing treated water:

- Agricultural irrigation
- Cleaning
- Car Cleaning
- Washing dishes and clothes
- Fire Extinguishing
- Construction work

### Opinions of al-Khalifa's inhabitants

#### Water problems:

- Low Pressure
- Sanitation system leakage
- Depression in floor level
- Underground Water

#### Water usage:

- Daily usage
- Casting of metal in some workshops in al-Khalifa

#### In case of fire:

- From the houses
- Public fire hydrant (Used in the past)
- Fire Engine (with difficulty)

#### Suggestion for reusing treated water:

- Agricultural irrigation
- Cleaning
- Ablution
- Fire Extinguishing



## 6. Agriculture (current practices and future potentials)



### Opinions of Zaynhum's inhabitants

#### Urban agriculture activities:

- The district contains some areas planted by the inhabitants.
- The crops include some vegetables and fruits for daily usage and consumed by inhabitants.
- Most of the inhabitants are willing to participate in planting if they are provided space for agriculture.

### Opinions of al-Khalifa's inhabitants

#### Urban agriculture activities:

- Some of the inhabitants plant vegetables in their balconies.
- Most inhabitants are willing to participate in planting if they are provided space for agriculture.

## 7. Garbage



### Opinions of Zaynhum's inhabitants

#### Current dump areas:

- Garbage is collected regularly from houses.
- Or else they leave the garbage in front of their houses and the garbage car collects it.
- Taken by inhabitants to nearest dump area (the factory).

#### Dump areas suggested by inhabitants:

- Most inhabitants suggested the ridge as a suitable place for garbage dumping.
- Some people suggested that the place should be near without suggesting a certain spot.
- A few people suggested that there is no need for a dump area as the garbage is regularly collected by garbage collectors.

### Opinions of al-Khalifa's inhabitants

#### Current dump areas:

- Garbage is collected regularly from houses.
- If garbage collectors do not pass by, inhabitants throw garbage in the street garbage bins or in the ridge.

#### Dump areas suggested by inhabitants:

- Most inhabitants suggested the ridge as a suitable place for garbage dumping
- One of the inhabitants suggested a place in front of Shajar al-Durr dome



**Recycling and selling garbage project:**

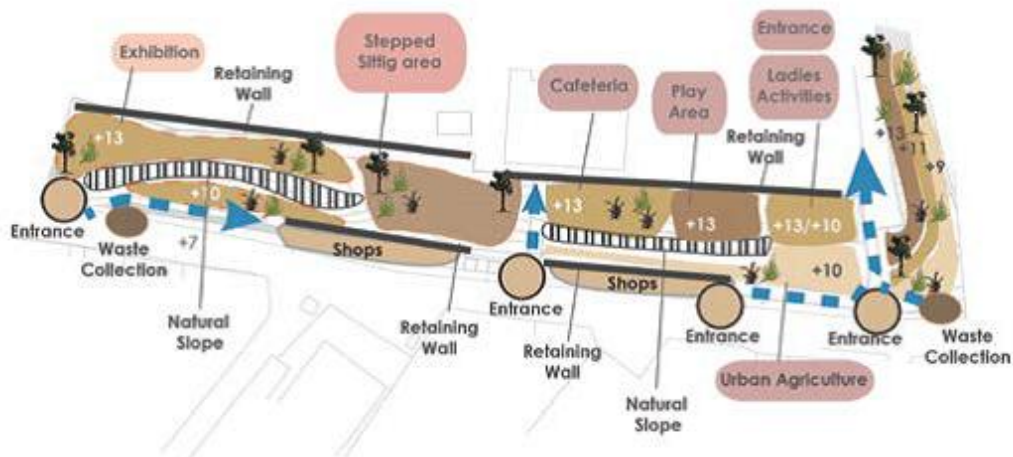
- Inhabitants think that the project is a good idea and they are willing to participate, however they believe that it will be difficult to implement it due to the lack of time, lack of awareness about waste sorting.
- Inhabitants think the project would be useful for increasing income especially for those in need.

**Recycling and selling garbage project:**

- Inhabitants think that the project is a good idea, as it will help in getting rid of the garbage while reusing it for other purposes; however, they believe that it will be difficult to implement it due to the lack of time and lack of awareness about waste sorting.
- Inhabitants think the project would be useful for increasing income especially for those in need.
- Some problems may arise with garbage collectors, as it will affect their work.
- A few people think that the project won't be useful.



## 8. Park Management



### Opinions of Zaynhum's inhabitants

#### Entrance Fees Payment:

- 90% Agree.

#### Park Maintenance & Security:

- Entrance fees payment
- Someone should be responsible of the park
- Need for security guards
- Managed by Private Sector
- Strict Control
- Regular checks

#### Potentials of the public park:

- Safe place for children
- Does not cost the parents a lot of money, as it is located in the area.
- Entertaining Inhabitants.
- Entertaining Children
- Education and development of children if there is a nursery.

#### Problems of the public park:

- The crowds might cause security problems.

### Opinions of al-Khalifa's inhabitants

#### Entrance Fees Payment:

- 85% Agree, if it is a small amount of money.

#### Park Maintenance & Security:

- Entrance fees payment
- Someone should be responsible of the park
- Need for security guards.
- Making sure the park is clean.
- Government should be responsible of park security.

#### Potentials of the public park:

- Public utility enhancement for the district
- cleanliness
- Entertaining and gathering people.
- Entertaining Children
- Beautiful and comforting view

#### Problems of the public park:

- Lack of awareness
- Security problems



ABOUT ATHAR LINA



## APPENDIX I ABOUT ATHAR LINA

Athar Lina is a participatory conservation initiative to establish modalities of citizen participation in heritage conservation based on a vision of heritage as a resource not a burden. Based in al-Khalifa in Historic Cairo and run by the Built Environment Collective | Megawra ([www.megawra.com](http://www.megawra.com)), Athar Lina believes that only when cultural heritage is beneficial to the community, will the community become an active partner in its conservation. It believes that conservation can be a vehicle for development if practiced in a participatory inclusive manner. In order to enable the community to become an active partner, workshops and research projects are developed and implemented to determine the priorities and devise strategies. These are a necessary step towards implementation of feasible impactful interventions.

To motivate the participation of the community and sustainability of the interventions, heritage and projects, conservation is combined with social development and tourist promotion activities. Furthermore, the projects target children as one of the principal beneficiaries, hence the introduction of the educational program.

Athar Lina started in June 2012 with a participatory design workshop focusing on the neighbourhood of al-Khalifa in Historic Cairo. This neighbourhood stretches from Ibn Tulun Mosque in the north to al-Sayyida Nafisa Shrine in the south and is known for its impressive, yet under-appreciated set of listed monuments dating from the 9th to the 19th century. The question asked was on the relationship between these heritage sites and their surroundings and whether they could become resources the community benefits from. The recommendations of this workshop focused on three main issues:

1. Identifying heritage nodes to conserve and rehabilitate for communal use
2. Children as prime targets for heritage awareness activities
3. Urban scale projects linking heritage to economic and social benefit through upgrade of public space, tourist promotion and capacity building.

These recommendations guide the work we do to this day. Projects implemented include the following:

1. Conservation of four domes from the 12<sup>th</sup> and 13<sup>th</sup> century and rehabilitation of an early 20<sup>th</sup> century building into a community centre.
2. Establishment of a heritage school for Khalifa's children, run on a daily basis in summer and on a weekly basis during school. Funding for this free school is through a heritage activity program for private schools and a heritage education consultancy.
3. Promotion of the tangible and intangible heritage of al-Khalifa through craft development and tourist programs. The craft program focuses on knowledge exchange activities between designers and local artisans as a means of raising the capacity of both groups. Tourist promotion is through an annual event of guided tours, street art, street performances, exhibitions and recreational activities called (Spend the Day in Khalifa).
4. Urban upgrade activities focusing on infrastructure, mostly waste management and groundwater problems. The waste management program focuses on the rehabilitation of dumps into recreational spaces. The first dump, in Darb al-Husr was converted into a football field and al-Khalifa Ridge is the second project. The groundwater issues are addressed through the Athar Lina Groundwater Research Project.

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**MEGAWRA AL-KHALIFA (KHALIFA COMMUNITY CENTER)**

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**TELEPHONE:** (+20) 106 702 1656

**FACEBOOK:** [www.facebook.com/AtharLina/](http://www.facebook.com/AtharLina/)



ABOUT AL-KHALIFA

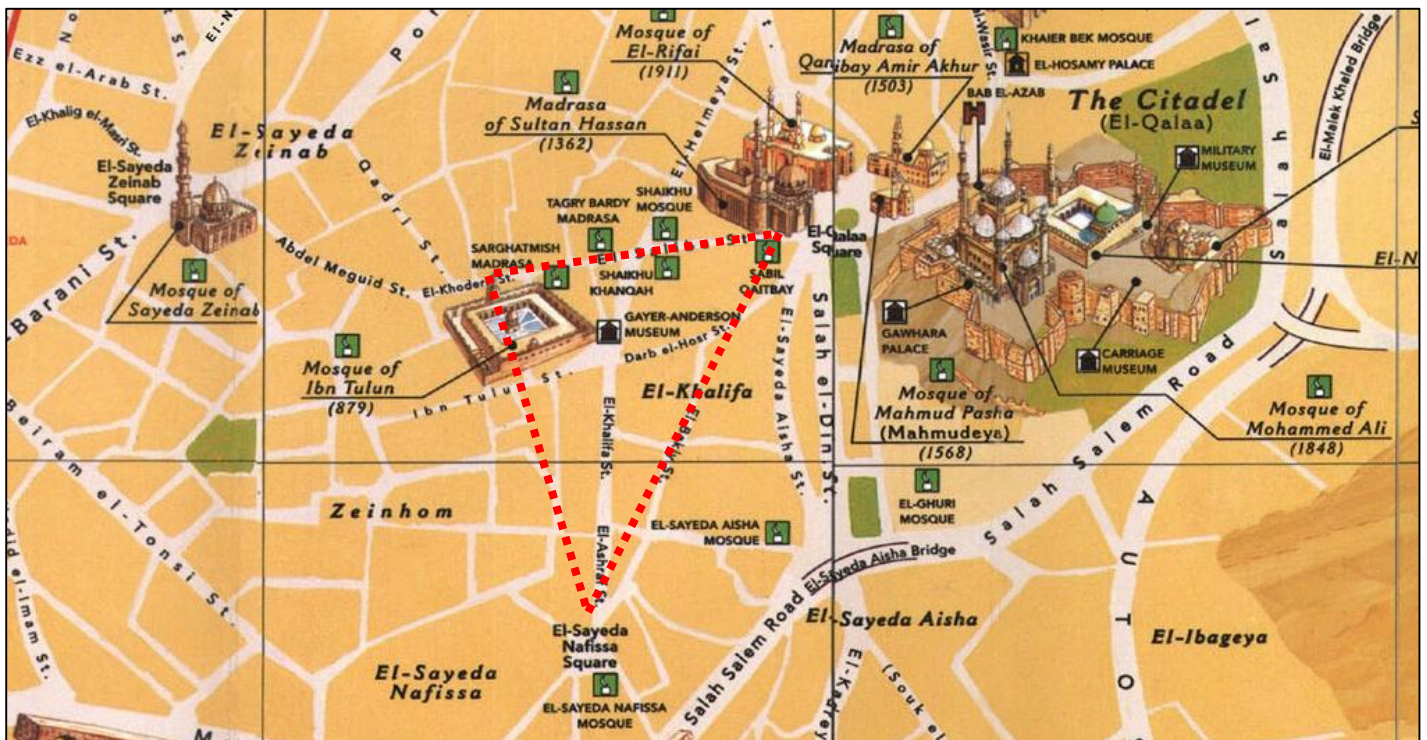
## APPENDIX 2 ABOUT AL-KHALIFA

### 1. Location and borders

The study area extends from Ibn Tulun Mosque in the North to al-Sayyida Nafisa Square in the South. It is triangular with Ibn Tulun and Sarghatmish Mosques marking the northwestern tip, Khushqadam Mosque roughly marking the northeastern tip and S. Nafisa Mosque marking the southern tip. Its main spine runs north south in the middle and is called, from south to north, al-Ashraf (also al-Balasi), then al-Khalifa, and then it branches into two streets, the eastern street called al-Rukbiyya and the western called Ibn Tulun.

Item	Number
Population	20085 persons
Area	253284 m <sup>2</sup> = 60.3 feddans
No. of parcels	1497 parcels
No. of residential units	5206 units
No. of inhabited units	4737 units
No. of non-residential units	775 units
Daily generated waste	9038 kg, about 9 tons

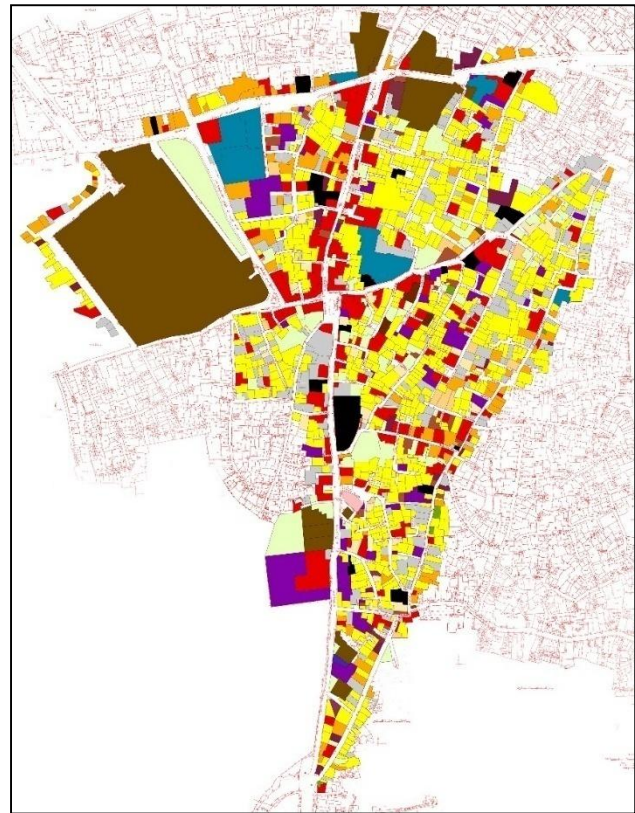
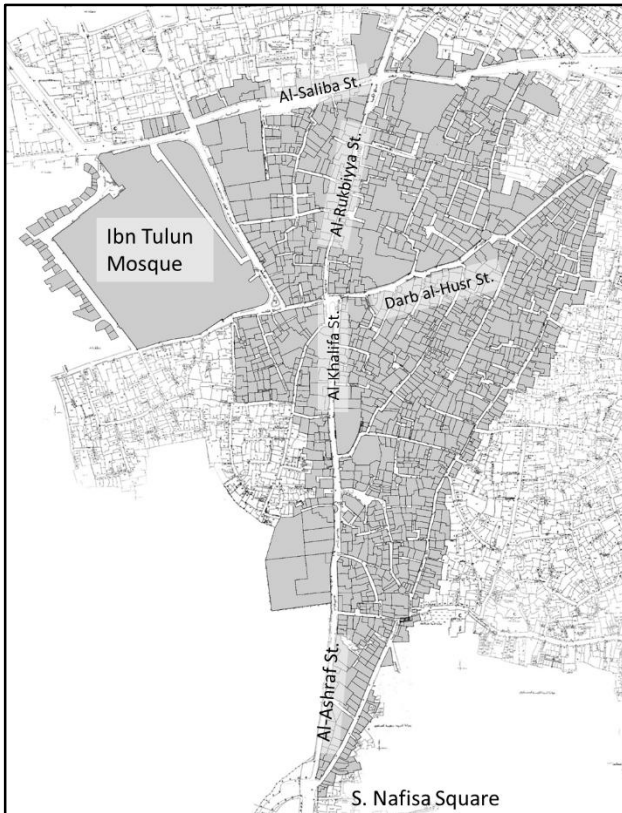
Left: Al-Khalifa – basic information



Location of al-Khalifa – North of S. 'A'isha Square and west of the Citadel.

Borders marked in red: Al-Saliba Street in the north, Al-Baqli Street in the East, S. Nafisa Square and Cemetery in the south and Zaynhum Housing and Ibn Tulun Mosque in the East. © mappery; <http://www.mappery.com/maps/Cairo-Egypt-Tourist-Map.mediumthumb.jpg>





Area borders. GIS map showing buiding functions – prep. BEC-Megawra team with Cairo University's Faculty of Planning and Takween



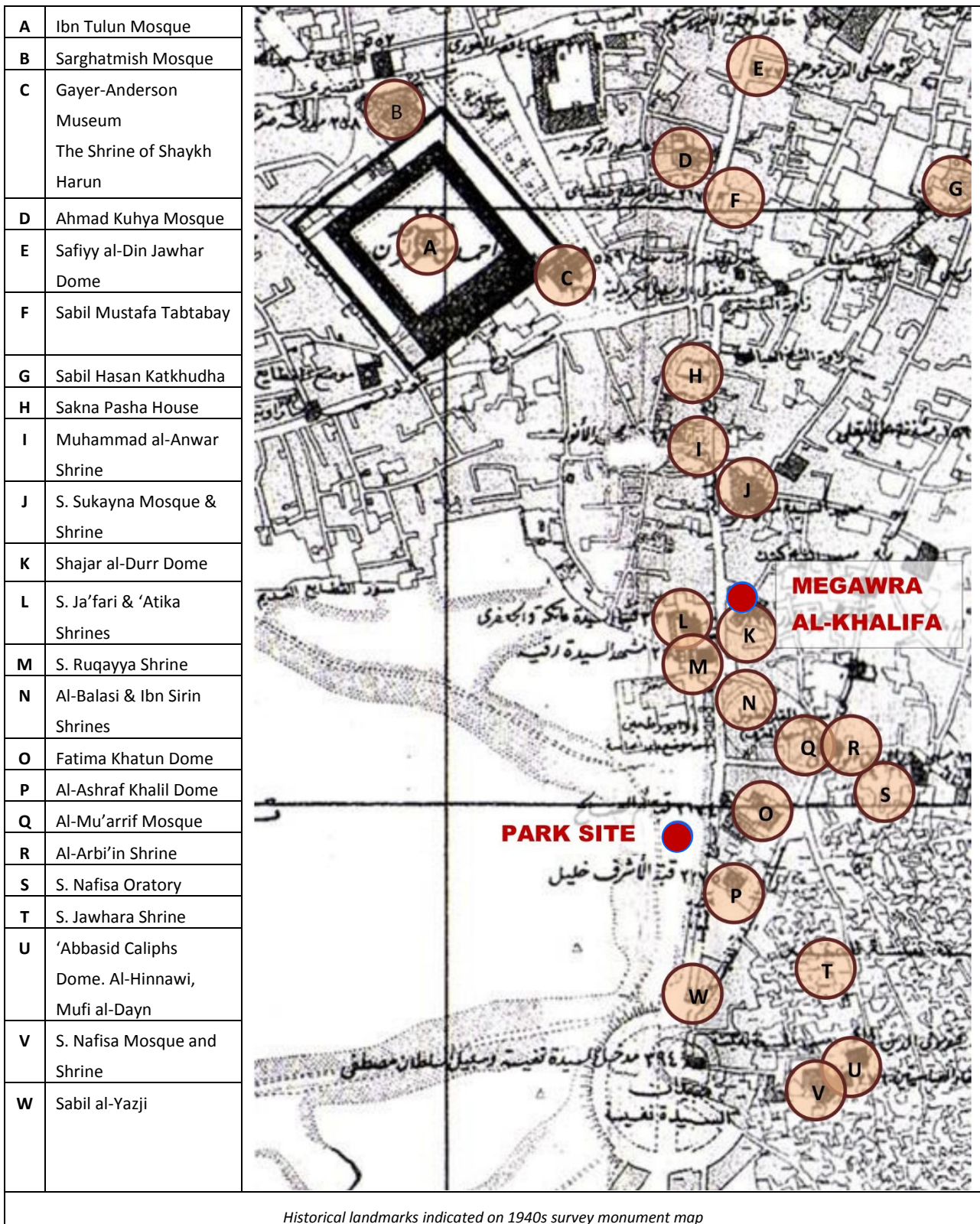
© Athar Lina

## 2. Main landmarks of the study area

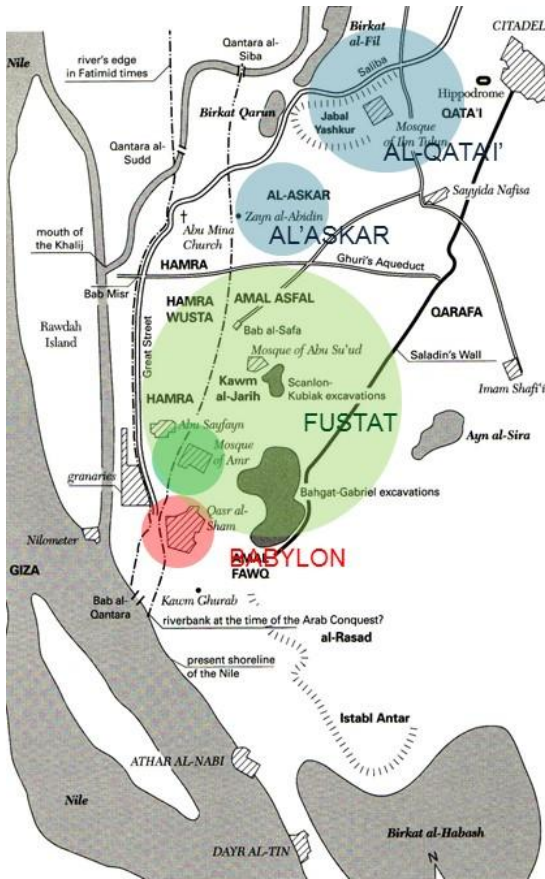
- The 9<sup>th</sup> century mosque of Ibn Tulun, centre of city of al-Qata'i', Islamic Egypt's first autonomous capital and Egypt's earliest mosque to have retained its original form (A)
- The Ottoman houses of al-Kritliyya and Amna Bint Salim constructed in the mid-20<sup>th</sup> century into a museum housing the collection of British officer Gayer-Anderson who lived in the houses in the 1930s (C)
- The 18<sup>th</sup> century house of Sakna Pasha given, along with the title of Bey, to Egyptian singer Sakna, by Khedive Ismail at the end of the 10<sup>th</sup> century (H)
- The Fatimid shrines of S. Ruqayya (M) al-Ja'fari and 'Atika (L), the Ottoman shrine of Muhammad al-Anwar (I), all descendants of the prophet Muhammad. This is in addition to the popular 19<sup>th</sup> century mosque and shrine of S. Sukayna (J), also a descendant of the prophet and other minor religious shrines such as that of Ibn Sirin, interpreter of dreams (N) and Shaykh Harun the patron saint of the house of al-Kritliyya (C).
- The mosques and madrasas of al-Ashraf Khalil (P), Fatma Khatun (O), Sarghatmish (B), Safiyy al-Din Jawhar (E) and Khushqadam, all religious and funerary structures belonging to sultans and amirs of the Mamluk regime. This is in addition to the Mamluk residential *qa'a* (residential hall) turned Ottoman Mosque of Ahmad Kuhya (D).
- Minor *sabils* (public fountain) from the Ottoman period (F, G) and from the 19<sup>th</sup> century (W)
- The dome of Shajar al-Durr (K), Islamic Egypt's only female ruler who is both the last of the Ayyubids and the first of the Mamluks. Adjoining it is the unfinished mosque from the 1920s now housing al-Khalifa Community Centre, the headquarters of Athar Lina and Megawra.
- The mosque and shrine of S. Nafisa (V), arguably Cairo's most popular shrine, lies within the historical cemetery of the same name which houses such gems as the dome of the 'Abbasid Caliphs (U), the Fatimid shrine of Mufi al-Dayn (redeemer of debts) (U) and the popular shrines of Sitt Jawhara (S. Nafisa's



companion) (T) and al-Hinnawi (patron saint of newly-weds) (U). The latter two mark the visitation trail of S. Nafisa which extends northwards to include her private Ma'bad (oratory) (S), the location of her home, the mosque of al-Mu'arrif(Q) and the shrine of al-Arbi'in (R), all marking epiphanous events in her life.



### 3. The urban development of the city



The urban development of Cairo in the Islamic period; left: Map showing development from 641 to 868 (base map © Andre Raymand, Cairo; right from top to bottom: Old Cairo (al-Fustat) today – Amr ibn al-As Mosque; Ibn Tulun Mosque

#### a. The beginnings of al-Fustat and al-Askar

The city of Fustat was established as Egypt's capital after its conquest during the spread of Islam in AD 642 / AH 20, on the banks of the Nile near the Babylon Fortress, an area currently known as Misr al-Qadima. It is at Fustat that the first mosque in Egypt was erected: 'Amr Ibn al-'As Mosque. After the demise of the Umayyad rule, a new capital was established by the succeeding 'Abbasids in Egypt. This new city was called al-'Askar and was located north of Fustat, and became the headquarters and site for the military encampment.

#### b. Al-Sayyida Nafisa

S. Nafisa lived in the zone between al-'Askar and Fustat in the neighbourhood of al-Maragha with her husband Ishaq Ibn Ja'far al-Sadiq during the 'Abbasid era. Nafisa was the daughter of al-Husayn Ibn Zayd Ibn al-Hasan Ibn 'Ali Ibn Talib and Zaynab bint al-Hasan Ibn al-Hasan Ibn 'Ali, making her a descendant of the Prophet Muhammad from both her parents' sides. She was known for her piety and temperance, in addition to her jurisprudence and interpretation of the Quran. The people of Egypt started gathering around her, to be close to her blessings, including the scholars and imams of that period. When S. Nafisa sensed the proximity of her death, she dug for herself a grave in her house. However, following her death during the holy month of Ramadan of AD 824 / AH208 her husband wished for her to be buried in al-Baqi', a cemetery in Medina close to the Prophet's Mosque. The people of Egypt were not happy with this decision and requested that she be buried in Egypt to bless her. Her husband agreed when he saw a vision telling him to do so. Al-Maqrizi writes that the tomb of S. Nafisa became known as one of the places in Egypt where supplications are answered. The site became popular for visitation which inevitably resulted in people digging their graves in the area surrounding S. Nafisa's grave for the proximity to her blessings. The first notable changes in



the area of today's al-Khalifa started with the S. Nafisa area which had become the seat of the cemetery and a place of visitation.

#### c. The origins of the City of al-Qata'i'

When Ahmad Ibn Tulun was sent to Egypt by the 'Abbasids in AD 868 / AH 253, he built the city of al-Qata'i' to be the new capital, northeast of the city of al-'Askar, spread over a square mile from *Jabal Yashkur* (Mount Yashkur) to *Maydan* (square) Ibn Tulun, later known as *Maydan* al-Rumayla and the Qaramaydan at the foot of where the Citadel is now. The city was named al-Qata'i' due to the way it divided or quartered the area for each of the army's denominations. Ibn Tulun built a mosque, the palatial complex (*dar al-imara*), a *maristan* (hospital), aqueduct and well in his new city. Dar al-Imara was built adjacent to the mosque; the two were connected by a door through which the governor could directly access the *minbar* (pulpit) in the mosque from the palace. The palace faced a parade ground and park, which contained gardens and a hippodrome. The Tulunid dynasty was short-lived as Ibn Tulun had established his and his successors' rule as independent from the Caliphate and in AD 905 / AH 292 the 'Abbasids reoccupied Egypt and in retaliation razed the whole city. Today only the mosque remains.

#### d. The foundation of al-Qahira (Fatimid Cairo) (969-1171)

At the start of the Fatimid rule, Fustat had expanded northward reaching Jabal Yashkur and southward till Istabl 'Antar. The city was split into two parts: the lower quarter in the southwestern area of Fustat, considered the part with the highest urban density containing markets, caravanserais, and the mint; and an upper quarter containing Jabal Yashkur, the foot of the Muqattam Plateau, and *Birkat* al-Habash (pond) which is currently known as al-Basatin. The upper quarter is considered the urban extension of the lower quarter and includes the residential part of the city. When the Fatimids arrived in AD 969 / AH 358 they built the walled northernmost quarter: al-Qahira. It became the heart of the capital in AD 1168 / AH 563, when Vizier Shawar transferred the government from Fustat to al-Qahira and set fire to the former in anticipation of the Crusaders' attack.

By the end of the Fatimid period (11<sup>th</sup> C AD), many of the older neighbourhoods were left to ruins due to famine, epidemics and economic and political crises. The area of al-'Askar and al-Qata'i' remained in ruins until a construction boom in the area during the second half of the 12<sup>th</sup> century AD. This included the extension of the main al-Qasaba (spine) through al-Qahira and Bab Zuwayla to S. Nafisa which was called al-*Mashahid* Street (shrines). Royalty and viziers would finance the restoration of the fallen shrines in the area, most of which are located on current al-Khalifa street and its surroundings. It was during this period that the shrines of S. Sukayna, S. Ruqayya, Ja'fari and 'Atika were built.

#### e. The Ayyubid period (1171-1250)

With the demise of the Shi'a Fatimid rule, their Ayyubid successors confirmed the Sunni doctrine and erased manifestations of Shi'ism throughout Egypt. They established Sunni schools to disintegrate the remnants of Fatimid rule, in the area of Bayn al-Qasrayn ("between the two palaces", located along al-Mu'izz li-Din Allah St.). They built the Citadel moving the seat of power and new government to outside the city walls. Al-Saliba Street was established from the Citadel westward past Ibn Tulun mosque and then southward to Fustat. At the end of the Ayyubid period, Shajar al-Durr wife of the last of the Ayyubid rulers, al-Salih Najm ad-Din Ayyub, built for herself a mausoleum close to the shrines of *Ahl al-Bayt* (the descendants of the Prophet Muhammad) along what is currently called al-Khalifa Street.

#### f. The Mamluk period (1250-1517)

Although the shrines were of great importance during the Fatimid period for their political agenda, their importance grew and took root during the Mamluk period, where al-Mashahid and al-Qarafa received great care and attention from the Mamluk rulers and the upper middle class resulting in the introduction of new facilities. During the Mamluk period these areas slowly transformed and became characterised as multifunctional spaces as opposed to being of a purely religious nature as was the case during the Fatimid period. To legitimise his rule Sultan al-Zahir Baybars had his sons buried at the 'Abbasid Caliphs Mausoleum, at S. Nafisa, which the 'Abbasid Caliphs built there when they settled in Egypt during the reign of Baybars after their downfall in Baghdad. Not long after, on al-Khalifa Street, near the shrines of the Prophet's descendants, Sultan Qalawun built a dome and school for Fatma Khatun, his wife and mother of his heir, which gave her the name of Umm al-Salih. Her son al-Ashraf Khalil built a dome and school adjacent to her complex.

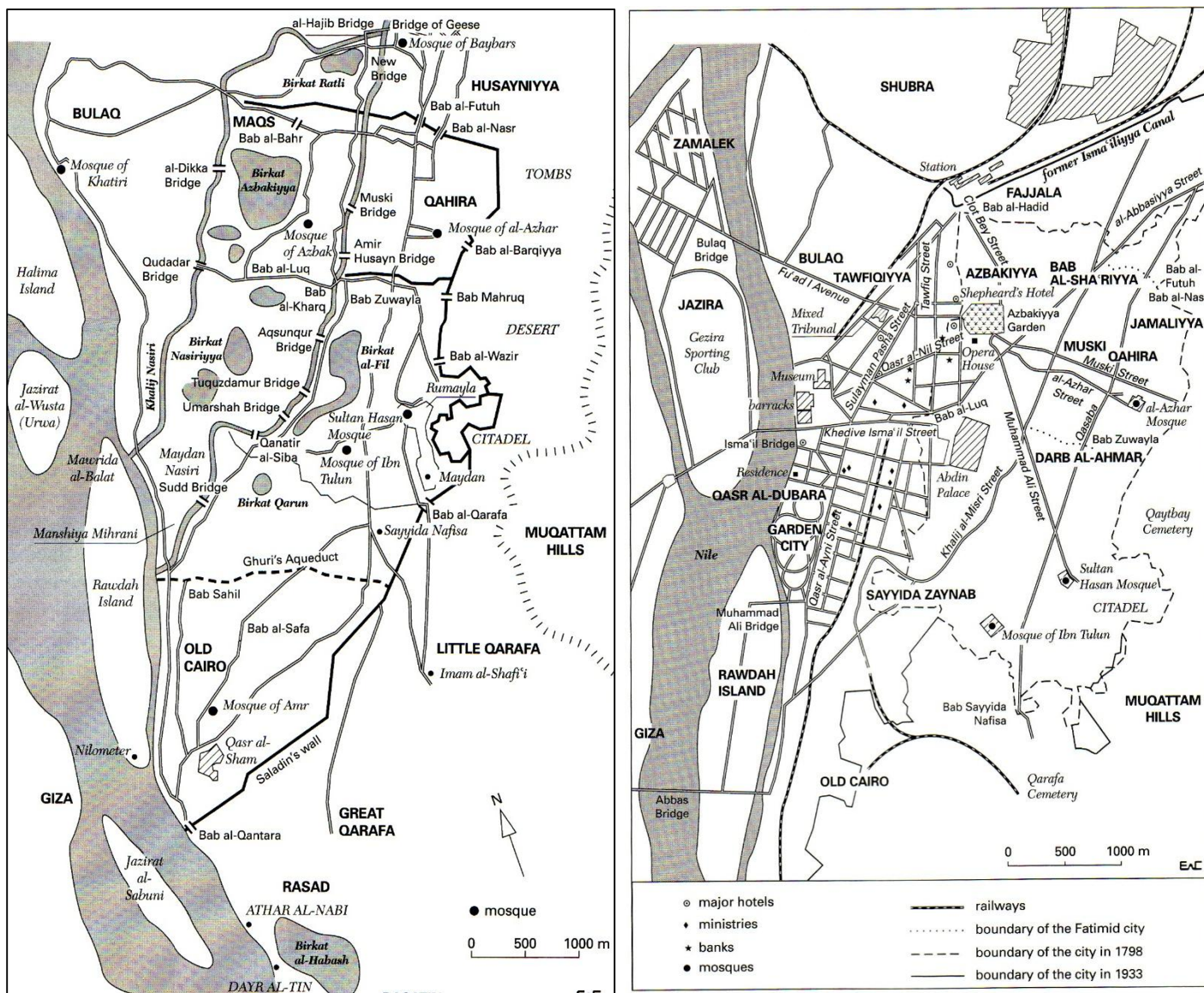
The area between the Citadel and Cairo underwent urban development during the Mamluk period, particularly during the reign of Sultan al-Nasir Muhammad (AD 1293-1341 / AH 693-741), in addition to the area north of Fustat. Due to the transfer of the seat of government to the Citadel, the princes and officials setup their residences around the Citadel. A number of markets were established in *Maydan Rumayla*. Despite the fact that Fatimid Cairo was a commercial center, the commercial activities and crafts workshops were located outside Bab Zuwayla and stretched all the way to the shrine of S. Nafisa. Al-Maqrizi has indicated the concentration of bathhouses inside the walls of Fatimid Cairo as well as between Bab Zuwayla and Ibn Tulun mosque showing the urban prosperity at the time. In AD 1314-5 / AH 714, al-Nasir Muhammad renovated the tomb of S. Nafisa and established a mosque adjacent to it. The 'Abbasid Caliph al-Mustakfi b'illah lived near the tomb of Shajar al-Durr in AD 1336-7 / AH 737. Interest in the area of the shrines along al-Khalifa street continued during the reign of the Bahri Mamluks, resulting in the renovation of the shrines of S. Ruqayya by al-Sharif Husayn Ibn Abu Bakr al-Husayni in AD 1440-1 / AH 844. The area was further popularised when Sultan Qaytbay issued a decree to establish the *mawlid* (observance of the birthday) of S. Nafisa which was attended by the Sultan himself, following his restoration of the shrine.

With the erection of the city walls in the Ayyubid era, and the aqueduct during the Mamluk period (which divided the Qarafa), the northern part of the city (including the area of S. Nafisa and the area connecting it to Bab Zuwayla) became enclosed. The rest of the *Qarafa* stretching southeast at the foot of the cliffs was left outside the walled perimeter to which the shrine of S. Nafisa became a figurative gate to the city while *Maydan al-Rumayla*, at the foot of the Citadel, was considered the political gate of the Sultanate. During the Mamluk period the road connecting the shrine of S. Nafisa and Cairo made it the starting point for visits.

#### g. The Ottoman Period (1517-1798)

A number of *sabils* were constructed in the area surrounding the S. Nafisa shrine. One of these was constructed by Isma'il Katkhuda in AD 1751-2 / AH 1165, accompanied by a gate and fence around the shrine of S. Nafisa in AD 1756 / AH 1170, as well as Sabil Sultan Mustafa built between AD 1736-55 / AH 1149-69 near his gate. This gate was demolished during the project that created *Maydan S. Nafisa* in the 20<sup>th</sup> century AD. Other *sabils* include those of Hajj Omar Bakir (AD 1775 / AH 1168) and Sabil al-Yazji (19<sup>th</sup> century). The large number of *sabils* is evidence that during the Ottoman era, the area of S. Nafisa was highly populated and visited. Abd al-Rahman Katkhudha commissioned the restoration of the shrine and mosque of S. Nafisa and built a private well that drew water with a waterwheel, in AD 1757-60 / AH 1171-3. This well supplied water for all the surrounding buildings through underground pipes, as recorded in the endowment documents, which also reported the construction of ten buildings some of which housed visitors to the shrine. Katkhudha then proceeded with restoration work on the S. Ruqayya and S. Sukayna shrines. He provided the later with the construction of a mosque; light posts; and piping to take bring water to it, a bathhouse and surrounding residences from the well at S. Nafisa. He also allocated the proceeds from

the surrounding real estate to the maintenance of the shrines. In the case of Sayyidi Muhammad al-Anwar, the shrine was rebuilt with the addition of a *zawiya* (oratory), minaret, ablution fountain and well. Katkhudha's work on the shrines has not survived. In the two decades following his interventions, the shrines underwent another round of renovation by al-Murtada al-Zabidi who built a shrine with a *maqsura* (space enclosed by a screen) and *zawiya* near S. Ruqayya for his wife who was buried there in AD 1782 / AH 1196. He built a small house near the shrine where he lived until his death in AD 1791-2 / AH 1206. He was buried near her.



Left: Cairo in the early 15<sup>th</sup> century; at the end of the 19<sup>th</sup> century © Andre Raymond, Cairo, maps 6 & 12

#### h. Modern Egypt (1804-present)

The area of S. Nafisa and its shrines received much attention from Khedive 'Abbas I +who was known for his passion for the descendants of the Prophet Muhammad. In AD 1850 he renovated the copper dome over the *maqsura* of S. Sukayna. This was accompanied by the restoration of the shrine of S. Ruqayya which included returning the preceding *maqsura* to the shrine which al-Amir Katkhuda had moved from the shrine of al-Husayn to S. Sukayna. This was followed by the expansion of the *takiyya* (sufi hospice). Both of these underwent further expansion under the direction of Tawhida, daughter of Khedive Isma'il. Abbas I also renovated the mosque of S. Nafisa and the restoration of the *maqsura*. Some of the doors, and the marble, these works continued until AD 1855-6, completed under the reign of Khedive Muhammad Sa'id. Under the rule of Khedive Isma'il, a *takiyya* was built for the Qadiriyya Sufi order within the school of al-Ashraf Khalil, which was setup as an endowment. This well-known order branched

from the *takiyya* at S. Nafisa. Adham Pasha, caretaker of the S. Nafisa mosque built housing for sufis, as well as an office near the mosque, while supplying water for both of these. Khedive 'Abbas II renovated the shrine of S. Sukayna. During the mid-nineteenth century AD, Mahmud al-Yazji built a *sabil-kuttab* (public fountain and Quran school) at the start of S. Nafisa Street, only the *sabil* remains today and it is not registered as a historic building. In 1873 restoration works were extended to the dome of Shajar al-Durr which included the renovation of its mosque and terrace.

The *Comité de Conservation des Monuments de l'Art Arabe* (Committee for the Conservation of Monuments of Arab Art) was established by Khedive Tawfiq in 1881 for the preservation of monuments. At the start of the twentieth century the *Comité* removed the graves and buildings from the vicinity of the schools of Umm al-Salih and al-Ashraf Khalil, and undertook the restoration of the domes of Shajar al-Durr and the 'Abbasid Caliphs.

During the First World War, new efforts took place to restore the domes of Shajar al-Durr and S. Ruqayya. It was planned that restoration work on Shajar al-Durr would continue, with donations from Sultan Husayn Kamil, on the reconstruction of its ablution fountain, the creation of the *maydan* in front of the dome, the construction of a *zawiya*, as well as the reconstruction of the *takiyya* of S. Ruqayya. However, he died before the project was implemented in AD 1917. The *Comité* took the lead and implemented part of the project to revive the memory of Sultan Husayn Kamil, but it too did not continue. The project stopped after the removal of the old mosque of Shajar al-Durr and the incomplete construction of the *zawiya*. In the 1920s, a new traffic plan was designed for the area. *Maydan S. Nafisa* was implemented as well as the streets leading towards it, but the plans for the rest of the area were on hold until AD 1950. The *maydan* continued to undergo development until the early twenty-first century, which has been associated with the development of the Zaynhum area where the construction of public housing has taken place in the 50s and 60s. Cairo Company for Garbage Collection occupies part of the Zaynhum hill as a depot, alongside other facilities such as clubs, social centres run by local NGOs. Another youth centre, a library, a hospital, and a school, all of which services Zaynhum, occupy the western part of *Maydan S. Nafisa*. On the northern side of the *maydan* is the Maghrabi eye hospital. In addition to the changes of the *maydan* and the construction of the Zaynhum housing, which radically changes the S. Nafisa landmarks, the construction of the Salah Salim Road contributed to the isolation of the S. Nafisa area from the *Qarafa* cemetery, which stretches southward and eastward. These factors have also contributed to the traffic issue on al-Khalifa Street where many drivers take the street as a shortcut to the districts of S. Zaynab and Downtown to avoid the heavily congested Salah Salim Road.

Around the mid-20<sup>th</sup> century many factories were set up particularly along the southern section of al-Khalifa Street producing bread, ice cream, clothing and leather products. Most of them no longer function. In 1992 a large earthquake struck Egypt leaving many casualties and much damage in Historic Cairo. Many buildings collapsed or were left structurally unsound which were left abandoned or demolished. The Zaynhum project underwent an expansion phase under the sponsorship of Suzanne Mubarak, former First Lady, as one of the projects aimed to provide housing for those displaced by the earthquake. In the 90s the S. Nafisa mosque was reconstructed. In 2002, the Ministry of Tourism launched the project for the shrines of the descendants of the Prophet, which consisted of the renovation of al-Khalifa Street and the restoration of the shrines, but the project was not completed. The project called *Masar Ahl al-Bayt* (Descendants of the Prophet Itinerary) started with the beautification of the street which mainly focused on fixing facades also included plans to build a new mosque for S. Ruqayya adjacent to the shrine. In preparation for this buildings in the vicinity of the shrine were torn down. The plans for the mosque were put aside until 2015, when work for the construction of the mosque was started. In 2015, Cairo Governorate implemented a project in *Maydan S. Nafisa* to pave the streets and sidewalk and regulate traffic and parking.



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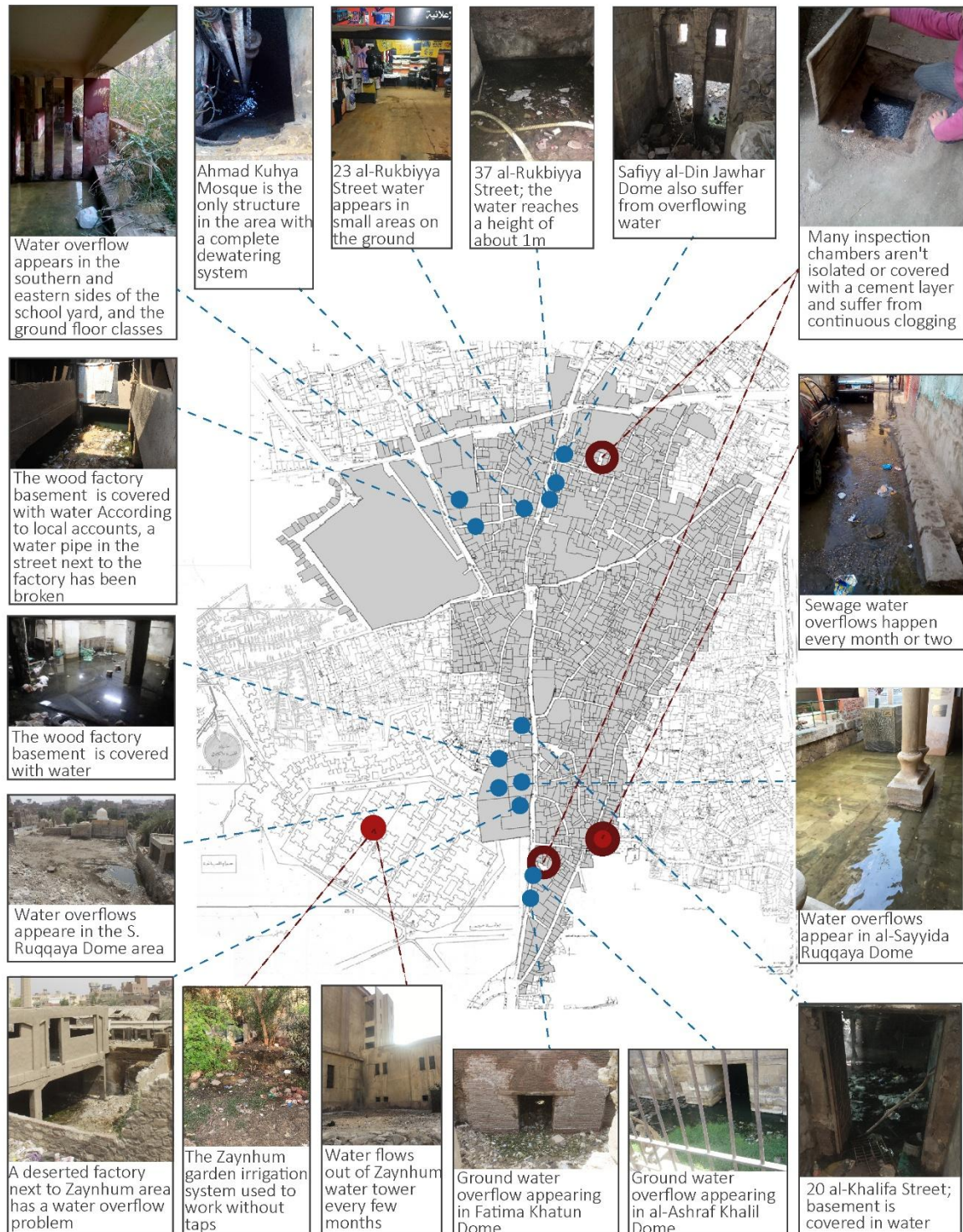
# GROUNDWATER IN AL-KHALIFA

## APPENDIX III

### PREVIOUS STUDIES RELATED GROUNDWATER IN AL-KHALIFA

#### 1. Detailed account of studies related groundwater in al-Khalifa.

For more info, check the report *Studies related groundwater in al-Khalifa* on the school website ([gwrpkhalifa.com](http://gwrpkhalifa.com))



Main sites with water problems in the study area.

## **2. Workshop : Mapping Urban Water Flow in Khalifa Using the Urban Metabolism Information System**

### **Aim of UMIS workshop**

As a part of the groundwater research project, the study of Water flow in Khalifa using UMIS aimed for two goals;

1. Estimating the amount of leakage from the water infrastructure; Analysis from subsurface water in al-Khalifa showed that the majority it is supply water leakage, therefore the amount of leakage from the supply network that UMIS calculates is important for knowing the amount of generated water that ends into the ground.
2. Knowing the different patterns of water use in the area; in order to plan for possible water reuse scenarios.

The workshop was organized by the Athar Lina team and Cairo University's team (as a representative of the Urbinsight project in Cairo). Thirty five participants with backgrounds in architecture, urban planning and civil engineering worked for three days on collecting, analyzing, and presenting the data and on brainstorming for ideas consistent with what this data suggests.

### **Total study area water flow**

The following diagram (Fig 1) demonstrates the final output of the study that shows the amounts of water used in the area in each use as well as the amount of leakages from the system. After subtracting the calculated demand in the study area generated by UMIS from the water pumped into the area by the water company, it was deduced that the percentage of leakage from the supply network into the ground in the area is about 25%.

### **Results of preliminary discussion session**

- Public building types (educational and religious) consume a huge amount of water compared to other types and a big amount of those could be grey water. However, when divided on the area population, these buildings contribute with a very small percentage to the person share.
- Although the leakage from water supply was estimated by 25%, the water problem appear in some places in the area more than others, which means that topography plays a big role in the water rise and that it must be taken into consideration that the leaked water can flow from one area to another inside Khalifa or from surrounding areas. Another issue that has to be inspected in the areas where water appears is nearby water pipes that could be fixed easily.
- Water use differs through the seasons
- Periodically checking water meters in the area can be used to double check the data

### **Water reuse scenarios**

- Using open spaces as nodes for groundwater extraction or storage or farming as a water reuse option.
- Using natural street slope to transport water from an area to another.
- Using above ground or surface pipes or drains to decrease the cost of infrastructure to transport the extracted ground water from an area to another.
- Reuse of water for toilets in mosques and schools.
- Reuse of water in marble or tile factories workshops which use a big amount of water (three were detected in the area)
- Reuse of water in roof farming.
- The Ashraf Khalil area was studied by several groups; the monuments are surrounded by rising water and are next to a big land plot that showed potential in several ways, it is suitable for use in agriculture, water storage

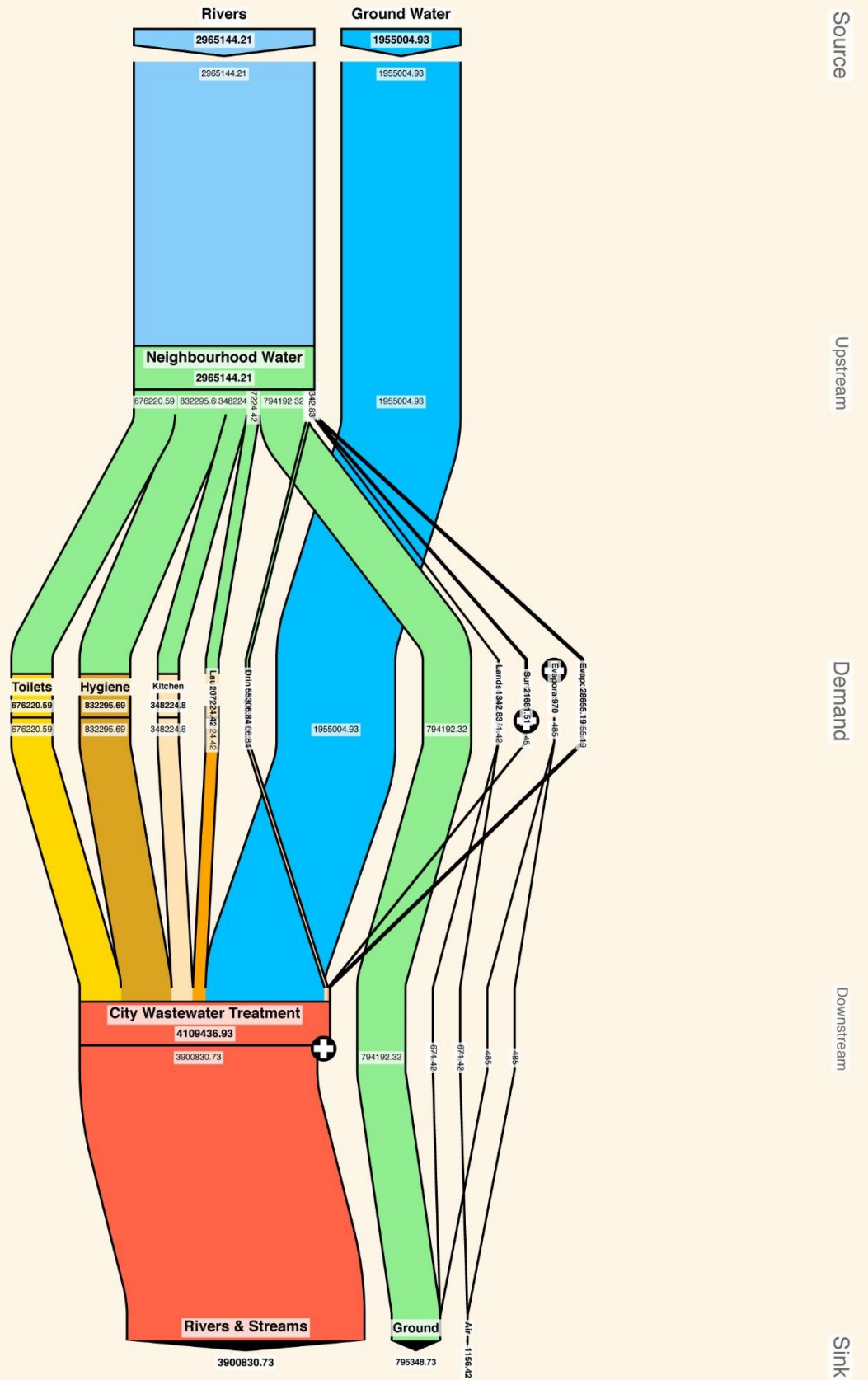


and since it has a higher level than the monuments, it could be used as a defense line to cut the way on the underground water flow.

- One group proposed a surface drainage system to transport the water from its extraction point, this system has several advantages, the system loses a chunk of the water due to evaporation along the way, it is accessible for water customers from the residents to use the water on its way and the drainage system can be designed with materials that purify the water on its way.
- A group suggested using septic tanks to purify and store water.
- Enclosed open spaces in the area are good candidates for community gardens.
- A group suggested decreasing water use (through awareness or greywater reuse in buildings) to decrease the water leaking into the ground by decreasing the total amount of water coming into the area.

*For more information, check the full report on:*

*[https://media.wix.com/ugd/8e52d4\\_9b551a63a259401596aa283924d53f6d.pdf](https://media.wix.com/ugd/8e52d4_9b551a63a259401596aa283924d53f6d.pdf)*



Khalifa study area water flow

### **3. Conservation School (Groundwater and Salt Damage to Historic Sites in Urban Contexts)**

**Nov-Dec 2016**

#### **About the conservation school**

A six-week conservation school aimed primarily at the Ministry of Antiquities employees. It engages 20 MoA professionals in addition to around 7 employees of Cairo Government, the Ministries of Housing, Environment and Endowments, in addition to the Water and Sewage Companies and the National Institute for Water Studies. Students and young professionals were also given a chance to audit sections of the course. Teaching was Sunday through Thursday from 9 am to 1 pm through lectures, fieldtrips, practical exercises, discussions and peer exchange with a side program of public events. All the course activities took place in al-Khalifa generally with focus on the domes of al-Ashraf Khalil and Fatima Khatun as case studies.

#### **Conservation school output of relevance to the current workshop**

The participants were divided into 6 teams, two teams each for the northern, idle and southern sections of al-Khalifa.

#### **The goal was to produce solutions for the three issues:**

- Prevention of water waste
- Extraction, treatment and storage of groundwater
- Reuse of groundwater

The teams produced this in three steps, first through general ideas then through strategies on the area level then interventions on a specific site level.

#### **The proposed interventions then were evaluated according to the following goals of the project:**

- The significance of the historic fabric and the importance of cultural heritage
- The need for livability and thermal comfort
- The desirability of economic enhancement/activity/redevelopment
- The importance of anticipating potential impacts of climate change (water will become that much more precious)
- Other goals

#### Exercise 1. General Ideas

##### Prevention

- a. Installing water meters for each housing unit is essential for more efficient consumption as accurate gauging of water will be of economic benefit for residents and provide a motive for reduced consumption. The meters cost about 1000 pounds but the resident will get back this money from what he saves in a couple of months.
- b. Using low flow caps for taps.
- c. Using sensory taps or taps that automatically close after a certain period of time.
- d. Periodic maintenance.
- e. Putting fines on damages to the water network, in cases where a facility does not fix its plumbing and has unresolved leakage.
- f. Determining hot spots for leakage in the network.
- g. Awareness campaign and boards advocating water efficiency especially in schools, mosques, clubs, restaurants, cafeterias and residential buildings.

- h. Training kids in schools on maintenance of networks and including it in the curriculum with practical exercises, in addition establishing student committees that monitor the state of the sanitation.
- i. Making direct drainage from sink water to toilet flushing boxes with the excess going into the sewage.
- j. Putting laws that require new buildings to have grey water reuse systems.
- k. Separate ablution water in mosques from wastewater, to be directed to reuse and decrease the load on the current network.
- l. Decrease the water pressure from source to decrease leakage.
- m. Renew the network by gathering money from residents in addition to private investment. The economic and environmental benefit comes from saving water. Also there is a community benefit due to the collaborative work and capacity building in fields of maintenance of the network.

### Extraction and treatment

- a. Use open spaces as nodes for treatment and storage.
  - b. Use the difference in levels of the area and natural slope to move and store water.
  - c. Treatment using sand filters, filtering pipes that are on a level below the ablution sinks, where water flows by gravity through sand and gravel for an improved quality.
  - d. Treat and store water from ablution in underground tanks and sand filter tanks. The advantage of being underground are:
    - No need for pumping from the sinks.
    - No structural threats to the old buildings when the tanks are situated beneath courts and yards of the mosque.
  - e. Store the water in old cisterns and tanks under the ground in the area.
- Phase (3) Reuse
    - a. Reuse in car wash.
    - b. Using water for watering and cleaning of the streets and the public and residential buildings.
    - c. Using water in industries with high water consumption in the area (for example tiles and marbles) or near the area (potters area in al-Fustat).
    - d. Inserting crafts or industries that consume a lot of water, for example pottery or industries.
    - e. Roof farming in roofs surrounding the mosques from ablution water, or using it for irrigation for open spaces next to these buildings.
    - f. Watering existing green spaces in clubs or gardens.
    - g. Creating green spaces, wet lands and water bodies.
    - h. Creating green spaces within the context of cemeteries. Many streets there are very wide, too wide for its current use, by transforming parts of the street to green spaces; we improve the current urban fabric, improve livability, and create opportunity for gathering and economic activity.
    - i. Use water for fish tanks (fish farms).
    - j. Use water in fire extinguishing tanks in the dense urban fabric; the historical fabric of Historic Cairo does not allow for easy access by fire trucks, by using these tanks we are sensitive to and preserving the historic fabric.
    - k. Use grey water for flushing; some suggested directly, others suggested after treatment and pumping to roof to be reused
    - l. Making streams for water (uncovered) that filter the water along the way and make it accessible for use.
    - m. Irrigate trees for wood production.
    - n. Create fountains.
    - o. Gather water and transport it to the nearest desert area for irrigation.



## Exercise 2: Interventions on area and site level

The northern section focused on the mosques of Ibn Tulun and Ahmad Kuhya and the Dome of Safiyy al-Din Jawhar, the middle section on Shajar al-Durr, Sayyida Ruqayya, Ja'fari and 'Atika and the southern section on al-Ashraf Khalil and Fatima Khatun and the ridge. The latter two groups also included Zaynhum Housing in their focus.

### Northern Section:

Area level strategies included repair of plumbing and networks in public buildings with high water consumption and focusing on them for water reduction and treatment measures. It was also proposed that the natural slope of the terrain could be exploited to transport water through gravity. Site-specific interventions focused on the existing dewatering system in Ahmad Kuhya and extraction and treatment of water from its manholes. Another group focused on installing a dewatering system in Safiyy al-Din Jawhar. Proposed uses included, fire hydrants, surrounding workshops, roof farms, fish farms, flush toilets and recreational areas. An empty plot was also identified as a node for water storage and reuse.

### Work samples:

- Group 1



*The disputed land plot (striped grey), the school (yellow left) and the mosque (yellow middle)*







*A proposed solution to the ground water problem in Safiyy al-Din Jawhar Dome and its surroundings*

**Middle Section:**

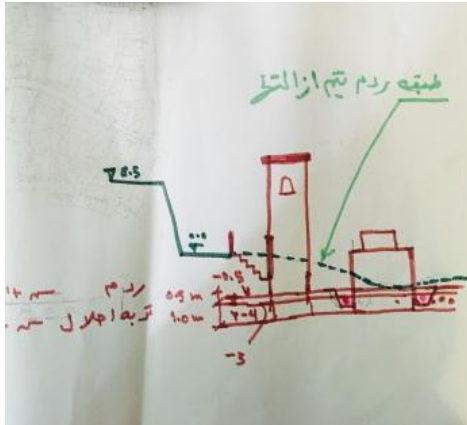
In addition to general approaches close to those arrived at by groups 1 & 2, this group noted the existence of springs and cisterns in Zaynhum and old cisterns around the historic zones (all currently covered) and referred to the possibility of uncovering and using them. Area related strategies focused on taking advantage of the 8 M level difference between Zaynhum and Khalifa and on directing reuse to high-water consumption activities such as a carwash, tile factory and laundry. They also indicated the need for caution in dewatering so as not to harm historical buildings. Site specific solutions focused on the need to introduced a treatment and reuse component in the proposed dewatering system for al-Sayyida Ruqayya, using the water in the new mosque for cleaning, irrigation and fire safety and using the roof of the new mosque for storage of water, potentially greening it too. They also proposed the introduction of consumption reduction measures in the new mosque (low consumption taps, reused flushwater, etc.). Participants also referred to the potential of the flour mill and bakery land as a node for treatment and reuse of extracted water.



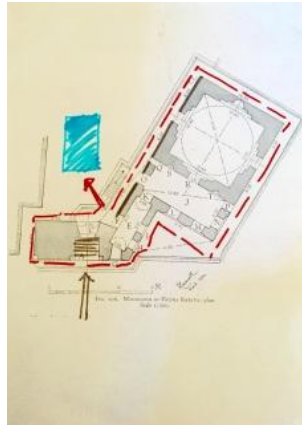


Work samples:

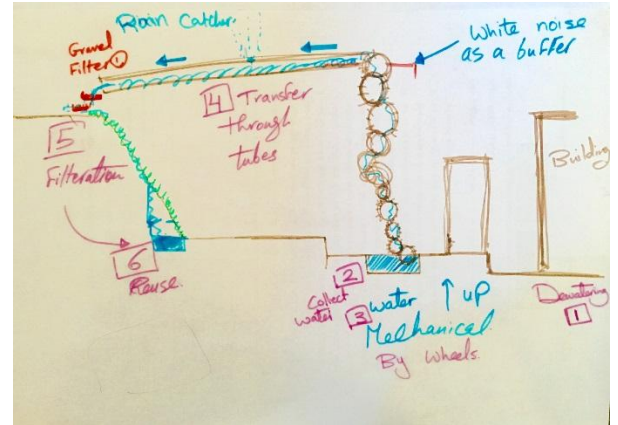
• Group 5



Levels of the domes and the ridge



Dewatering and storage



Water wheels system



Zones of interventions and sections for vegetation and storage



A proposal for processed water networks in Zaynhum and the cemetery

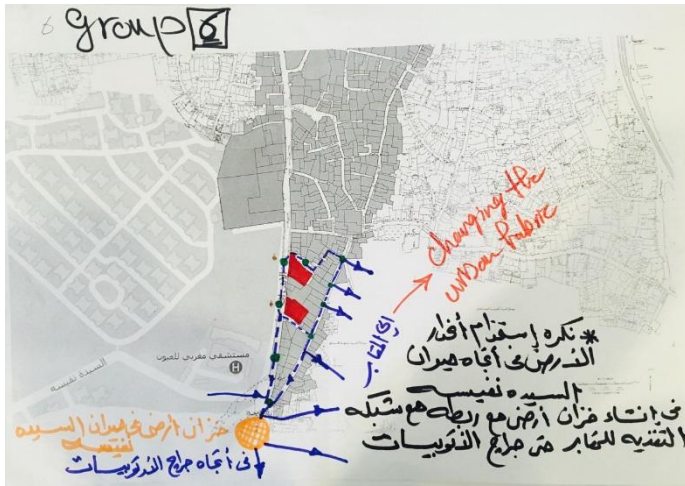
• Group 6



A tile factory in the area, causes usual manhole clogging, the group proposed moving the tile factory or disconnecting their network from the main network



Collect water from historic buildings (Fatima Khatun and al-Ashraf Khalil) by collection pipes then to pump rooms and then to tanks for treatment and to drip irrigation network to cultivate the ridge as steps



Use the slope of the land in the way to S. Nafisa Square to install a ground tank under the square. This tank supplies water to the cemetery water network.



Install a network for irrigation of green areas in the cemetery – other suggestions for use included shrimp farms