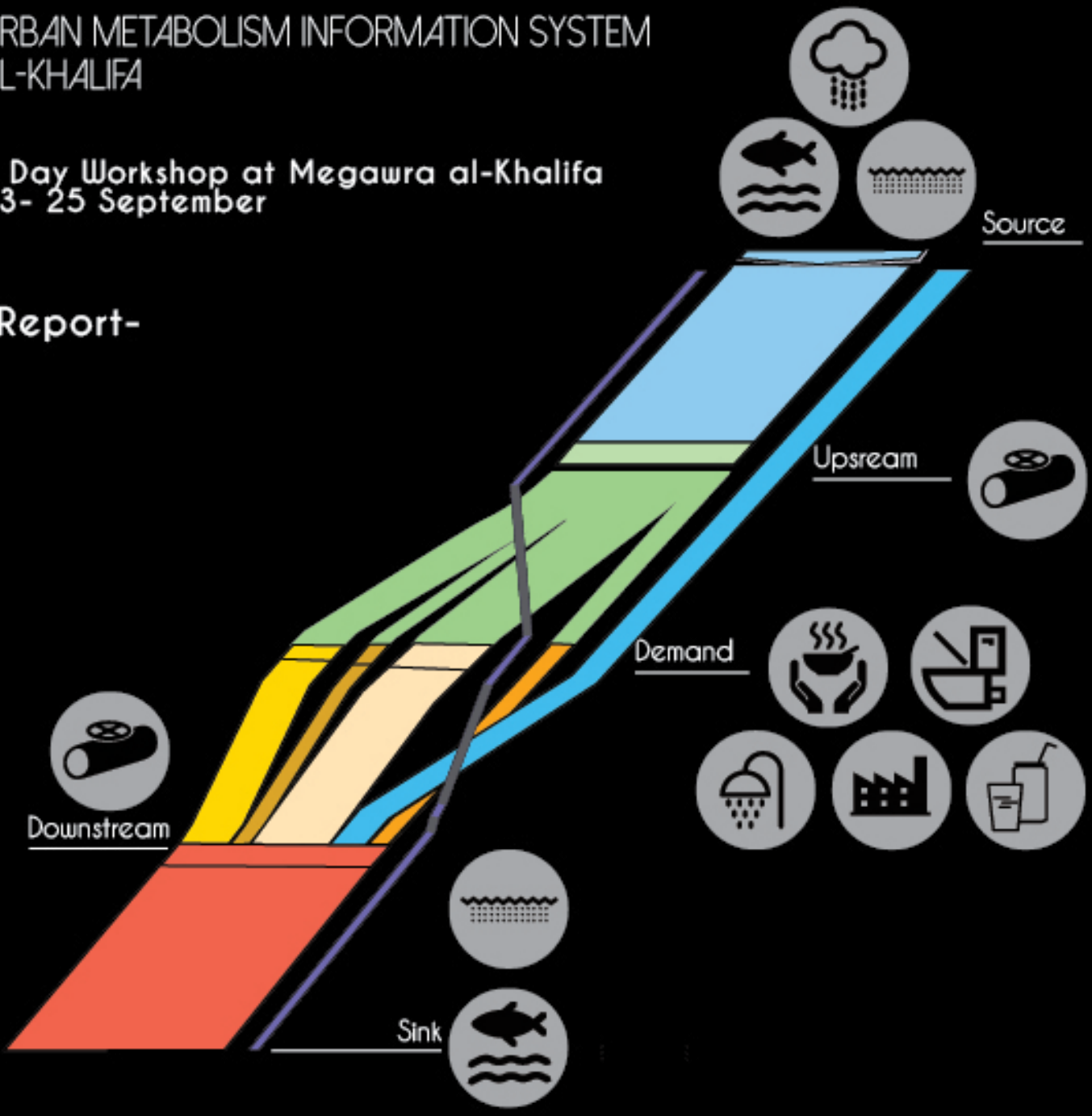
MAPPING URBAN WATER FLOW

URBAN METABOLISM INFORMATION SYSTEM AL-KHALIFA

3 Day Workshop at Megawra al-Khalifa
23- 25 September

-Report-



Contents:

1.0 Workshop Schedule

Mapping Urban Water Flow Workshop

Day 1: Fri Sep 23, 2016			
9:30 - 10:00	Registration	Athar Lina team	Megawra al-Khalifa
10:00 – 10:30	Introduction to the workshop and the ground water problem in al-Khalifa area	Athar Lina team	
10:30 – 11:00	A talk by the head of Cairo University team Professor/ Sahar Attia	Professor Sahar Attia	
11:00 – 11:30	Introduction to urban metabolism and previous experiences of the "Urbinsight" project	Cairo University team	
11:30 – 13:00	Coffee Break		
13:00 - 14:00	Division into teams and training on using UMIS	Cairo University team	
14:00 – 17:30	Field work and data gathering	Cairo University team	
17:30– 18:00	Wrap-up the day	Athar Lina team	

Day 2: Sat Sep 24, 2016			
9:30 – 10:00	Registration	Athar Lina team	Megawra al-Khalifa
10:00 – 13:30	Field work and data gathering	Athar Lina team	Al-Khalifa district
13:30 – 14:00	Coffee Break		Megawra al-Khalifa
14:00 – 17:30	Data entry into UMIS	Athar Lina team Cairo university team	
17:30 – 18:00	Wrap-up the day	Athar Lina team	

Day 3: Sun Sep 25, 2016			
14:00 – 14:30	Registration	Athar Lina team	Megawra al-Khalifa
14:30 - 15:30	Presentation on empirical work outcomes	Athar Lina team	
15:30 - 17:30	Division into groups and working on different scenarios for reusing the water	Athar Lina team	
17:30 - 18:00	Coffee break		
18:00 – 19:00	Participant presentations	Athar Lina team	
19:30 – 21:00	Open discussion: Lesson learnt, planning ahead, conceptualizing and structuring the water school.	Athar Lina team	

2.0 Methodology

2.1 General UMIS methodology

The Urban Metabolism Information System (UMIS) calculates the flows of water, energy, materials, mobility and ICT through the city.

It tracks the flow through five phases; source, upstream, demand, downstream and sink.
For example the source of water can be rivers, ponds, rainwater, ground etc.. the upstream can be the city water company, ground well, etc., Demand can be the uses; toilets, drinking, laundry, etc.. Downstream can be the waste water treatment plant and the sink can be rivers, sea, ground, etc..

The system then maps the amounts and types of different flows, it is also capable of mapping leakages and looping (reuse).
The data needed for the system are gathered from two different sources;
-For the source, upstream, downstream and sink phases:
The responsible government/private bodies responsible for handling the studied flow are approached for data specific to the study area (city, district, neighbourhood,..)
-For the Demand phase:
The buildings in a study area are classified into building types (archetypes) that are representative of the flow that needs to be studied. Then, a number of buildings of each archetype are surveyed. The survey sheet contains questions for the building users about their use and helping standards (average tap water flow per minute, standard toilet flush size,..).
After adding demand with the other phases in a file that represents the sample building. All buildings in the same archetype are averaged. Then, all the averaged files are multiplied by their number and aggregated by the UMIS files to produce a file representative of the study area. Finally, this file produces a CSV metaflow file that can be converted by Metaflow for Mac to a sankey Diagram.

2.2 Archetypes Classification

This workshop studies the water flow in al-Khalifa area. Therefore, the representative archetypes were chosen to cover different patterns of water use in the area.

The types were as follows:
- Residential (4490 housing units)*
- Commercial high water use (78 parcels)**
- Commercial low water use (291 parcels)
- Workshops (83 parcels)
- Religious (23 parcels)
- Educational (7 parcels)

* The standard archetype classification depends on parcels not units. However due to the high percentage of mixed use buildings and the big differences in height; the residential part of buildings was seperated from other uses, and the residential survey samples were gathered by the residential unit use not the parcel use like other landuses and later multiplied by the number of units and not parcels

** Due to the big difference between commercial uses in the area, the commercial parcels were classified into high water use and low water use. The high water use parcel would contain a type of the following commercial uses: Restaurant - Cafeteria - Juice Shop - Bakery - Laundry - Coiffeur . Other uses were considered low water use (ex: grocery, pharmacy, stationery,..).

Maps of Al-Khalifa's Archetypes are listed in Appendix 1

2.3 Government Data Analysis

Note that the study area is a part of the bigger Al-Khalifa quarter.

Census data

Al-Khalifa quarter population in 2006: *239656*
by multiplying the population decrease factor from 1996 to 2006, We estimated the population in al-Khalifa quarter in 2016 to be: *198987*

Water supply company data (source and upstream)

The Greater Cairo Drinking Water Company treats Nile water to supply greater Cairo with drinkable water. IT supplied us with the following data:
-Nearest water station pumping to Al-Khalifa quarter: *Al-Rawda Station*
-Average amount of water pumped Daily to Al-Khalifa area: *27,800 cubic meters daily = 27,800,000 litres*

Waste Water Company data (downstream and sink)

The Cairo Waste Water Company treats water from buildings east of the Nile in the city of Cairo. The waste water data were less specific as al-Khalifa's waste water directly flows to the main sewage tunnel of cairo under Portsaid street without passing on any intermediate stations, the tunnel directly flows to the main Cairo sewage treatment station (Al-Gabal Al-Asfar), therefore the nearest data about Al-Khalifa could only be found from Al-Gabal Al-Asfar station, the data were as follows :
-Average daily income to the station: 2,500,000 cubic meters = 2,500,000,000 liters
-served population: 14,000,000
-average person per day share: 178,6 litres

Application of water and sewage data to census and Megawra's urban survey data

-by dividing the water company supply to al-khalifa quarter by population from Census, the average person daily share of supply water = 140 litres
-study area population from Megawra's Urban survey: 21137
-by multiplying the average person share from supply water with the study area population, we get the study area's supply water share = 2959180 litres daily
-by multiplying the average person daily share of the sewage water with the stidy area population, the we get the study area's waste water share = 3775068.2

Since the UMIS system only uses percentages to calculate leakage and not quantities, these numbers will be compared later with the actual demand in the area to get the leakage percentage. Instead, standard percentages were assumed for the first calculation of the water flow.
The Supply water was estimated by a government report to be 60% in 2012, so this percentage was used. for waste water, 20% was assumed.

2.4 Data Gathering

The samples to be surveyed were set to represent of the total number of parcels of each archetype. Their numbers as follows:

- Residential (47 housing units)
- Commercial high water use (7 parcels)
- Commercial low water use (7 parcels)
- Workshops (7 parcels)
- Religious (3 parcels)
- Educational (3 parcels)

Then the area was divided into four zones each with its own set of maps (check appendix 3 for maps). The number of the participants in the wrokshop was 37 participants who were divided into teams. Each zone was covered by a suitable number of teams, so that each team gathers an average of 5-6 samples.
The participants used simmplified survey sheets that were translated into arabic.*

**All the sheets are copyrighted for Ecocity builders, so they were not included in this report.*

The participants were first trained on using the sheets, then they were briefed about Megawra's activities in the area and how to approach area residents, as well as general surveying ethics. Each zone had facilitators from both Megawra and the Ecocitizen World Map project supporting the teams in it.

2.5 Data Entry

The Data entry phase was carried on Megawra's commputers, as teams switched between computers to enter the data they gathered.
As some of the survey samples contained data described in a different way other than listed in the survey sheets, the teams also translated the data they gathered to fit the sheets. For example; a resident can estimate that they use 3 of a 4 liter bucket they have in a certain water use, the teams will have to calculate how much is this in liters per day and include it in the designated use. whereas in the standard procedure, the residents would directly answer questions concerning the frequency and interval of a use.

The Data then was averaged and aggregated by Megawra and the Ecocitizen World Map teams.

3.0 Output

3.1 Aim of the study in Al-Khalifa

This study serves as a primary stage for the Athar Lina groundwater project; an interdisciplinary training and research project involving an international team of architects, conservators, urbanists, ecologists, planners, and experts in infrastructure and water resources. The aim of this project is 1) investigate the phenomenon of rising ground water in historic settings and its effect on the historic built environment; 2) train key individuals from Egyptian governmental, professional and academic backgrounds in current trends for its treatment and 3) devise, prototype and pilot integrated approaches to treating and using extracted water.

The study of Water flow in Al-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 following diagrams show the study outputs that helped achieve those goals.

3.2 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 Substracting the calculated demand in the study area generated by UMIS from the water pummped 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%.

3.2 Total Study Area Water Flow

The diagrams in Appendix 4 show the patterns of use in the different archetypes. Note that there are two figures for residential use. Due to the big number of residential samples, it had to be divided into two groups to be averaged without a base for classification, resulting in two averages for residential use.

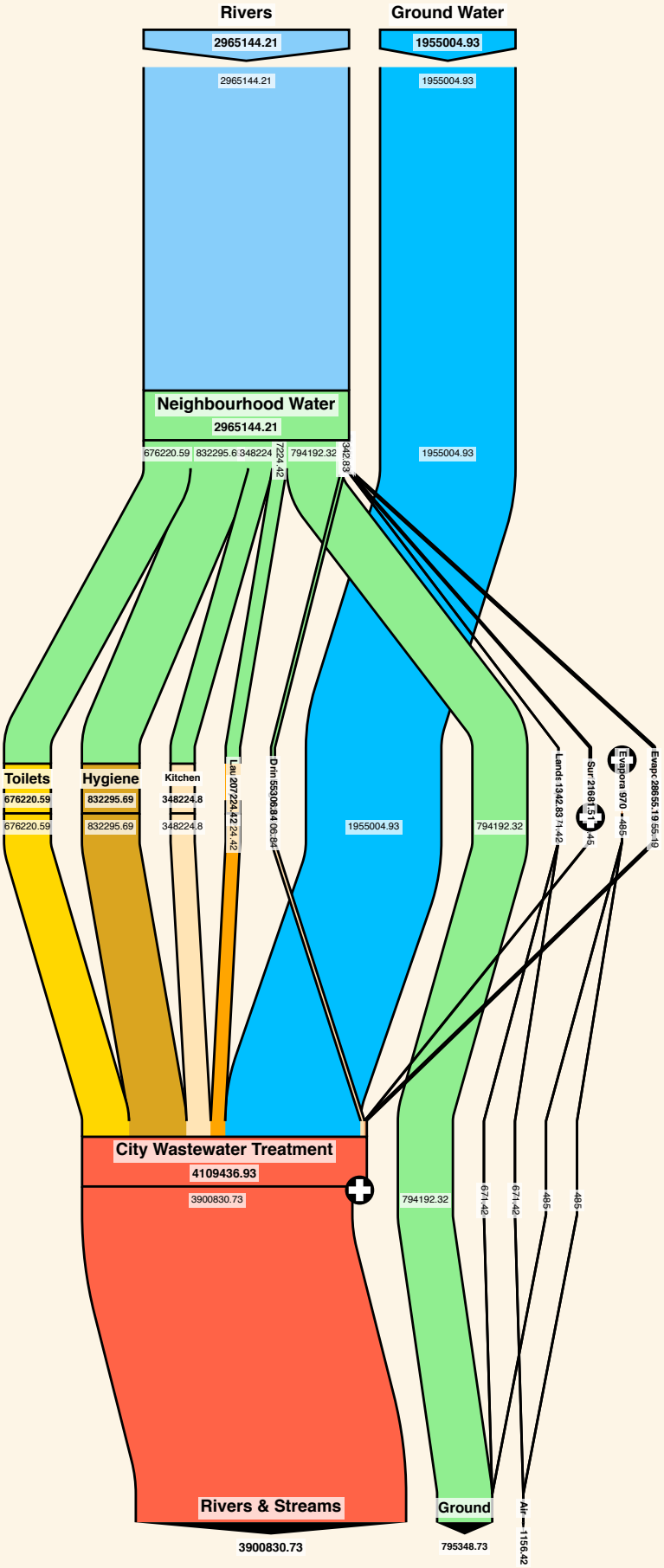


Fig 1: Total Study Area Water Flow

4.0 Discussion

4.1 Reflections About The Water Flow Analysis Findings

After the findings were presented to the participants, a discussion session was held where the participants brought up their reflections about the study. These reflections are listed below;
- 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 play 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 Al-Khalifa area 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

4.2 Recommendations For ground water reuse

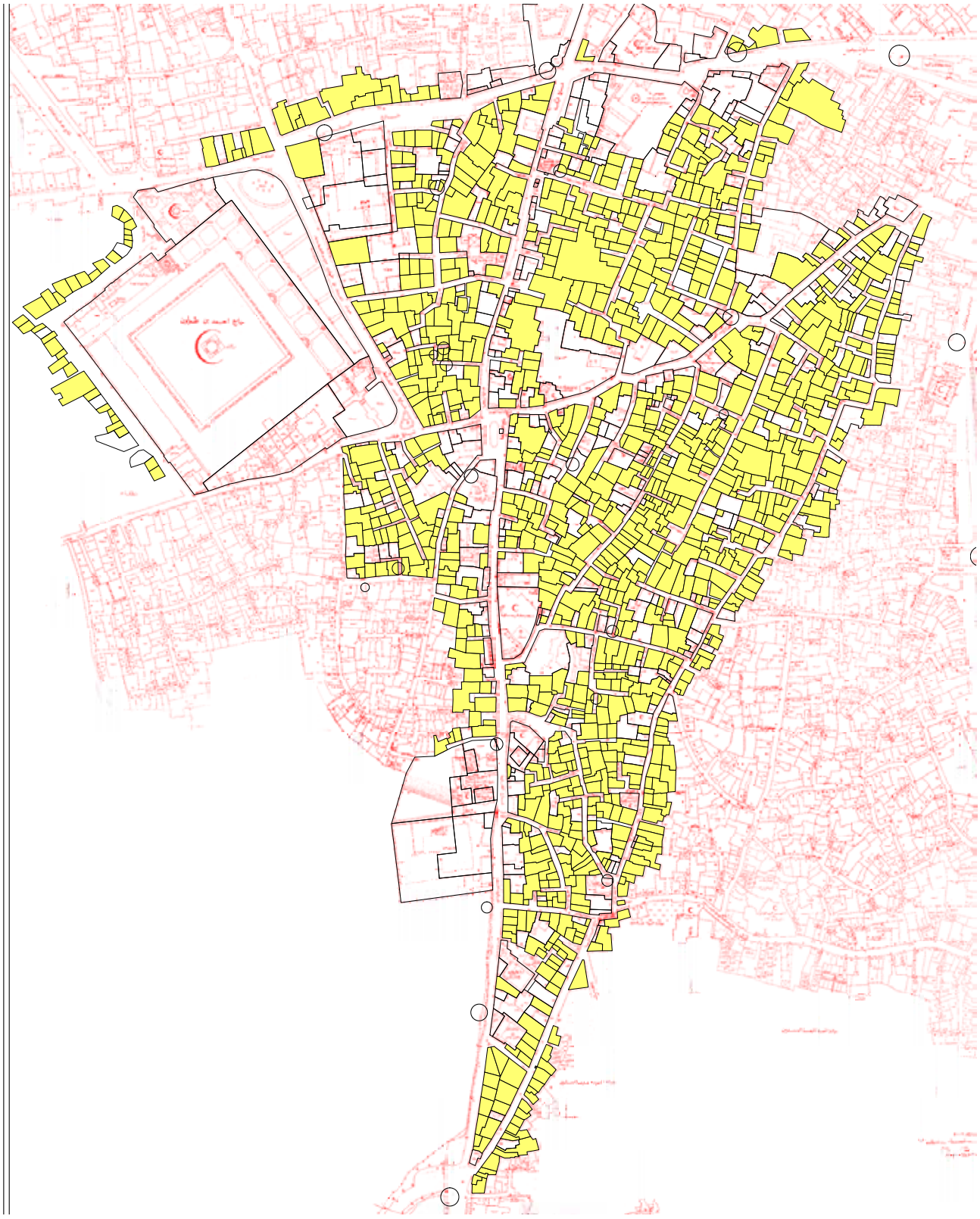
At the end of the workshop the participants were divided into four groups were they were worked on water reuse scenarios and presented them, the recommendations concentrated on the following ideas:
- using open spaces as nodes for groundwater xtraction or storage or farming as a water reuse option.
- 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 exrtracted 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 i agriculture, water storage and since it has a higher level than the monuments, it could be used as a defense linne 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 awarenes or greywater reuse in buildings) to decrease the water leaking into the ground by decreasing the total amount of water coming into the area.

5.0 Participant List

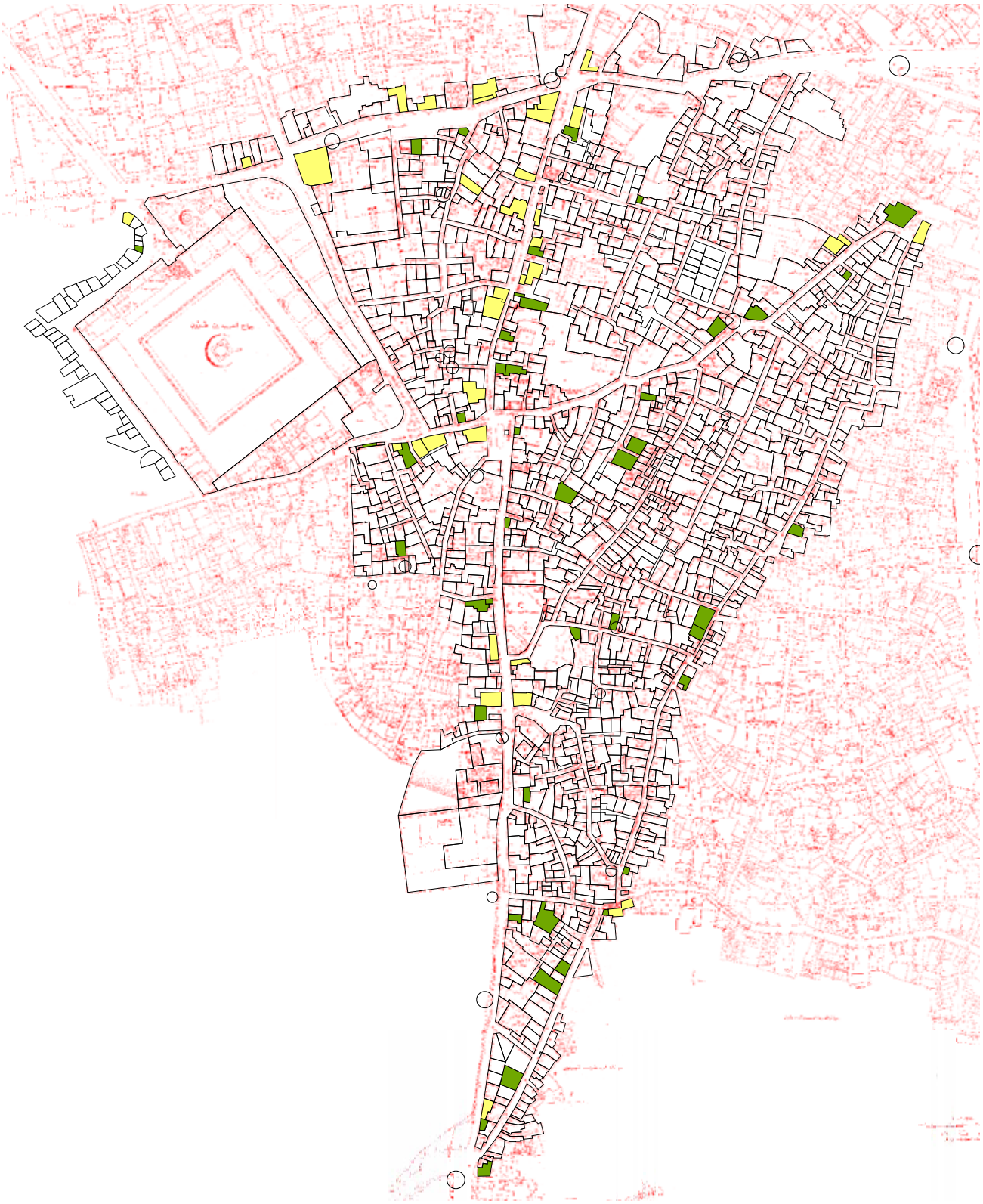
Name	Email	Mobile Phone (+20)	Organization	Background
Bassant adel hamza	Bassant.a.hamza@gmail.com	1113677712	GUC student	7th semester architecture student
omar farag	ofarag77@gmail.com	1111744097	none	Urban and environmental planner
Menna Essam	Menna.mhashem@gmail.com	1115754366	GUC	5th year architecture student
youstina youssef william youssef	youstina.youssef11@hotmail.com	1111749111	Cairo university Architecture department	a fresh graduate architect.
Sara mohamed rabie	Sararabie.94@hotmail.com	1144944407	GUC	Bachelor degree holder in architecture and urban design
Ahmed	Ahmed.elshoaby@yahoo.co.uk	1008375902	Freelance	Fresh graduate - Architect
Mohamed Abbas	arch.mohamedabbas@gmail.com	1111167317	Graduated from MSA University	I have no background of water flow, so that i want to join your team
Amr Yousef Mourad	amryusuf3@gmail.com	1007627553	Ezbet Project	Architecture
Maha Attia	maha_attia@live.com	1113141176	Fresh Cairo University graduate	Graduated from Architecture department, Faculty of engineering 2016.
Islam Ali Ibrahim	islamali_im@yahoo.com	1144460872	Architecture dep / MSA university	I don't have a back ground on this field but I know that this area is having a groundwater so it will be a good chance to facing such as this problem.
waled sadawy	waled_5520@hotmail.com	1146606760	alamar consulting group	civil engineering
Dalia Mohamed Fawzy Omar	engdaliafawzy@hotmail.com	1064160168	National Research Center	Architecture Engineering - Urban design and community development
Nouran Abdelrahman Ahmed	n.abdelrahman@hotmail.com	1118925042	freelancer building engineer	environmental building/ civil engineer
Karim Abdul Hameed Ezzat	karim.ezzat@hotmail.com	1097155304	German University in Cairo	Architecture and Urban Design/Site Surveying/Analysis and presentation skills/ https://issuu.com/karim.a.ezzat/docs/karim_ezzat_complete_portfolio_mini
eman mohamed metwally	archeman@yahoo.com	1115797302	gradution	graduate from archticter department cairo university
Aya Ahmed Samy	aya.ahmedsamy@hotmail.com	1018285065	Faculty of engineering cairo university	Graduated from Faculty of engineering architecture department cairo university
dina mamdouh	dmamdouh493@gmail.com	1121249102	cairo university,architecture department	urban and environmental
Mostafa Gouda	mostafa.agouda@gmail.com	1118757733	Environics	Urban Environmental Planning and GIS
Fady Francis	francis77701@live.com	1203034407	Cairo University	Architecture
Mohamed Ezzo	ezzomohamed93@gmail.com	1005654526	MSA University	Bachelor of Science (BSc) in Architectural Engineering
Omar El Hadidy	ohadidy@aucegypt.edu	1004604673	None	An Architect
Nourhan Abdel-Rahman	nourhan_abdelrahman@hotmail.com	1006660119	Cairo University	Architect and Urban Studies
hadeel mahmoud ezzat	hodhodmaio@hotmail.com	1066174949	cairo university	architecture
Aliaa' Mohamed Shokry	aliaa_shokry@live.com	1115566526	youthinkgreen	Architect, Cairo university.
Hossamelden Khaled	hossamelden.khaled@gmail.com	1006293959	German University in Cairo	Architecture and urban design
Shehab Kamal	shehabkamal14@gmail.com	1000618345	studying civil engineering at Ain shams university 4th year	organised sessions about environmental issues and sustainability,short knowledge about sanitary engineering and water networks in cities design , short knowledge about environmental economics
hanaa gad mahmoud	hana_gad24@yahoo.com	1118408700	Hawamish	architecture engineering
Taher Nabil Gamil	Taher.nabil@stp-egypt.com	1221804475	-	Fresh Grad Architect (Cairo University)
Heba Badr	Heba.badr@urbanics.org	1223803740	Urbanics	GIS consultant
Moataz Sherif Mohsen	moataz.sherif.mohsen@gmail.com	1158668634	Faculty of engineering cairo university 2011-2016	Fresh graduate architect
Doaa' Hossam El-Dein	doaa.hossam@live.com	1000186525	-	Fresh-graduate Architect
zeinab tahoon	zeinab_tahoon@yahoo.com	1004584687	i'm teaching assistant	i have a diploma in urban planning from menoufia university
Esraa Abdel-Wahab Shalabi	esraa.shalabi93@yahoo.com	1111711917	University	Urban Planning and Architecture
Mohamed Omar	m.abdelhamiedomar@gmail.com	1000275232	ESRINEA	Environmental Urban Planning and GIS & RS
Hoda gamal	Eng.hoda-gamal@outlook.com	1012880170	TA	Planning Diploma

6.0 Appendices

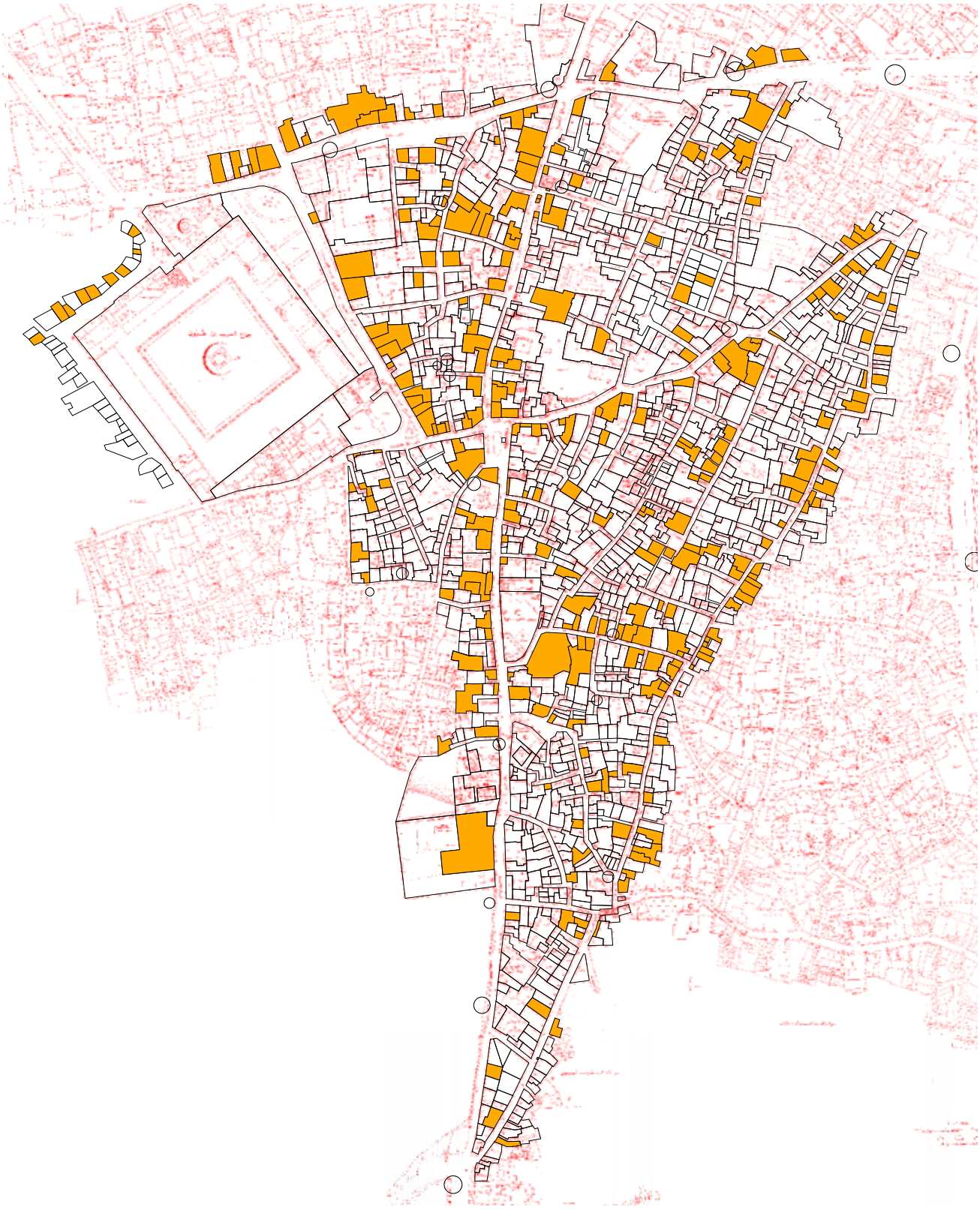
6.1 Appendix 1: Archetype maps



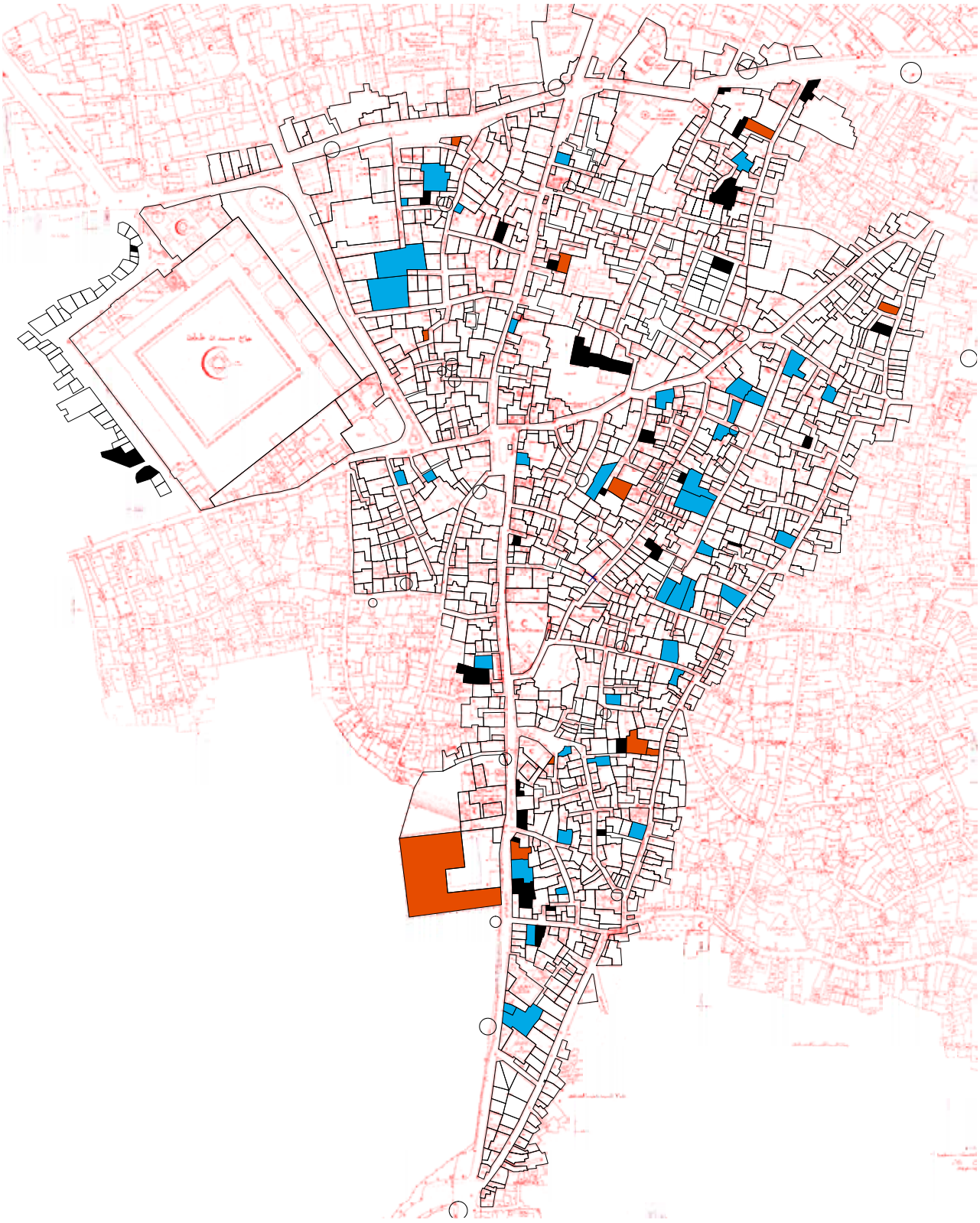
Residential



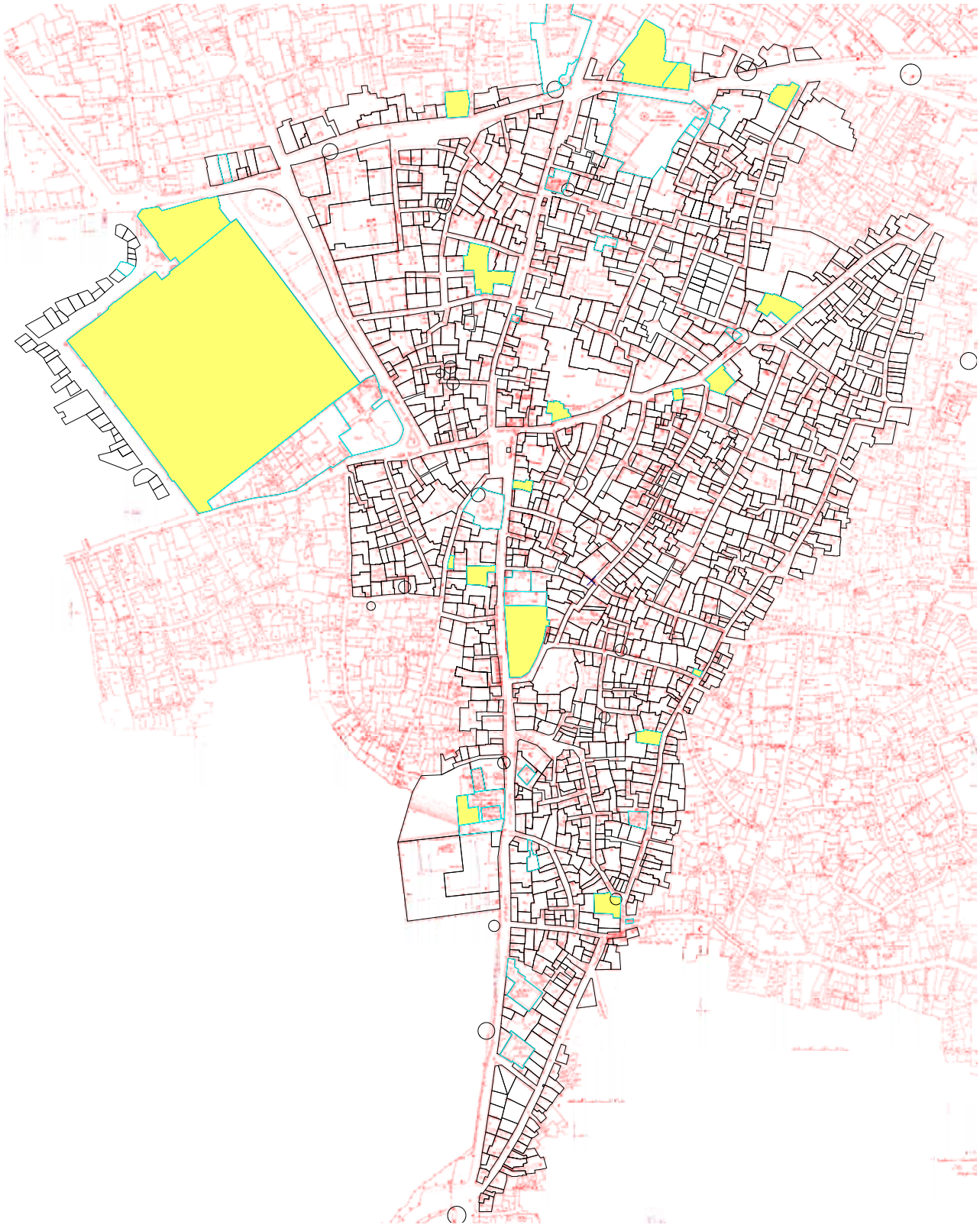
Commercial high water use



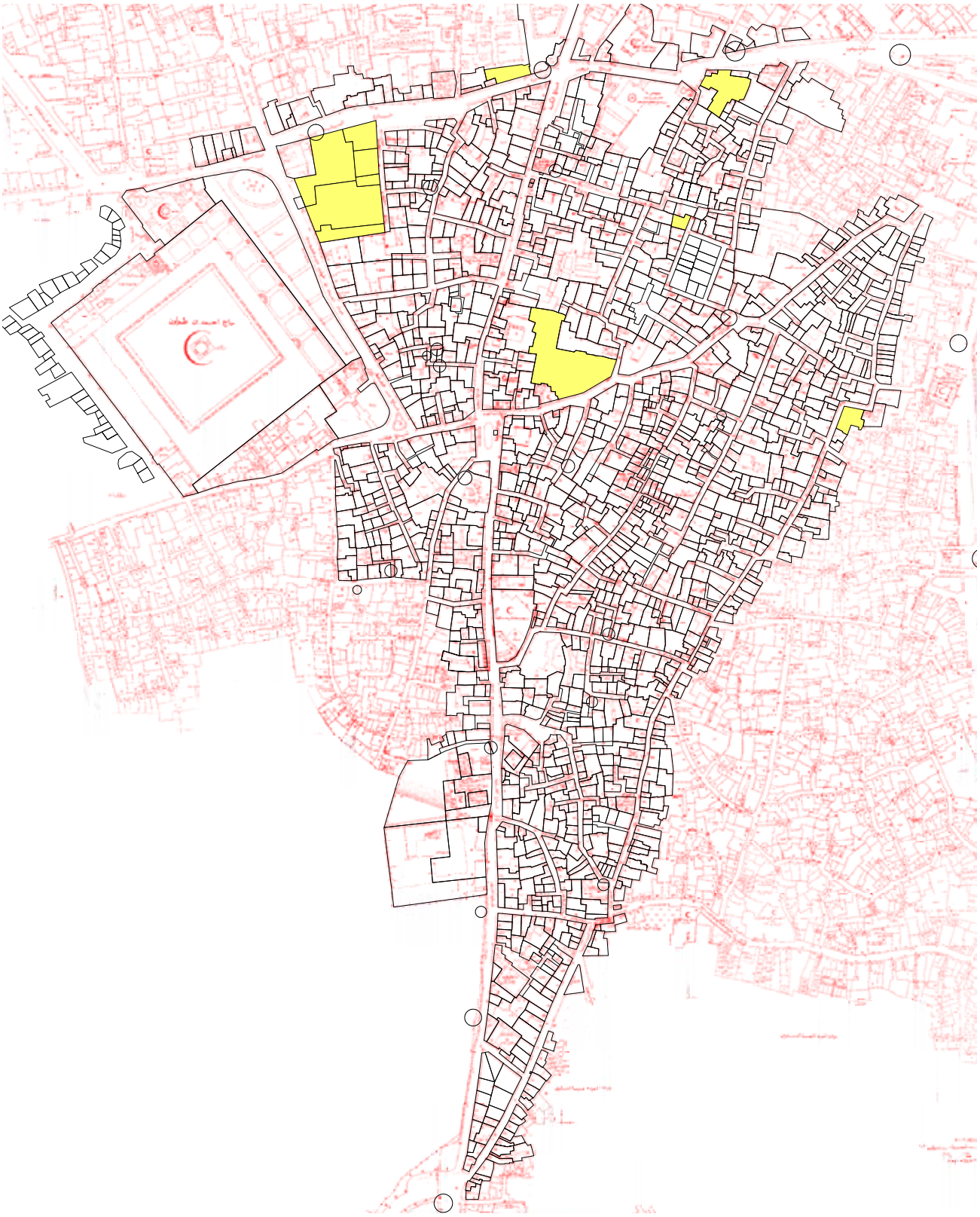
Commercial low water use



Workshops

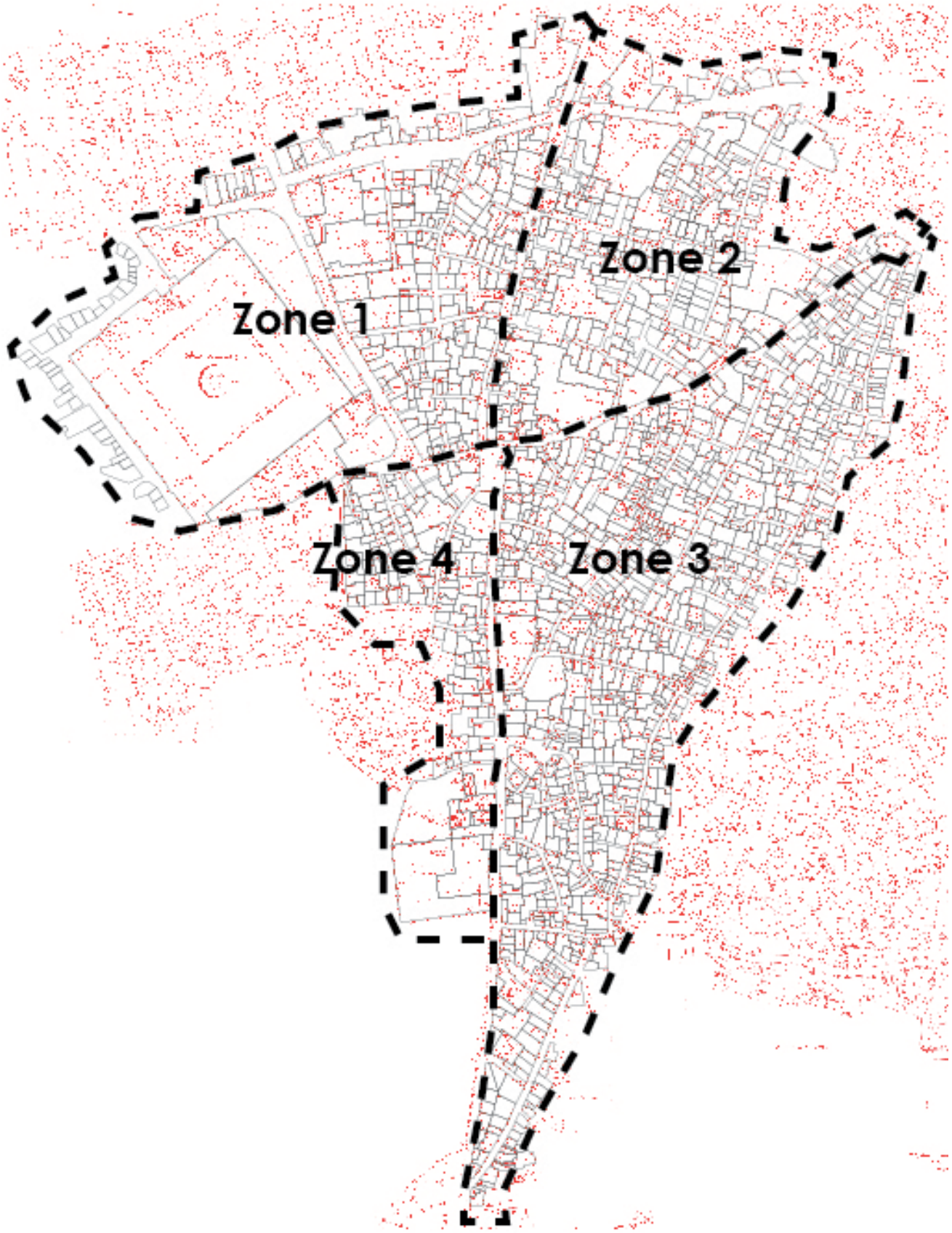


Religious

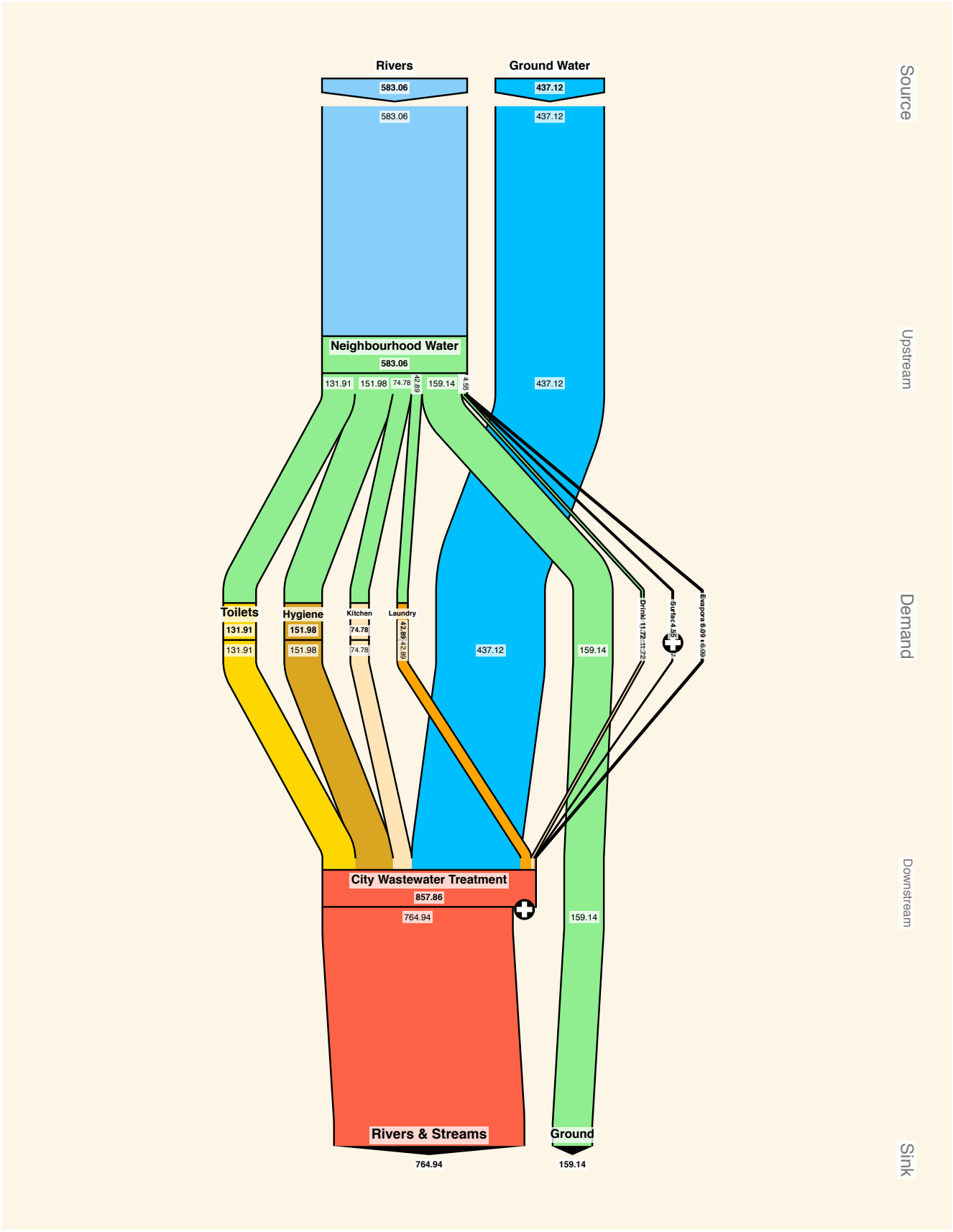


Educational

6.2 Appendix 2: Study area zones



6.3 Appendix 3: Archetypes Water flow



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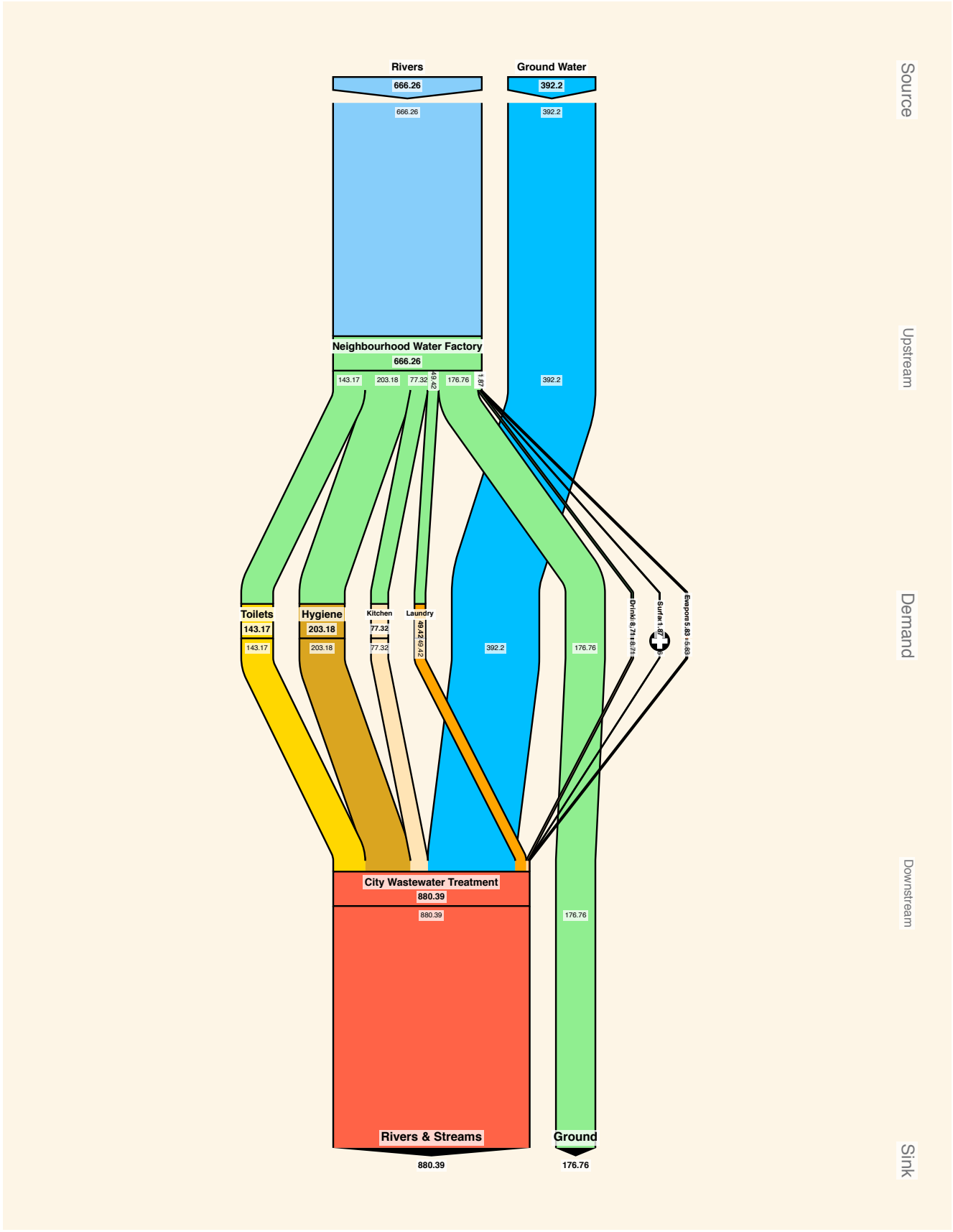

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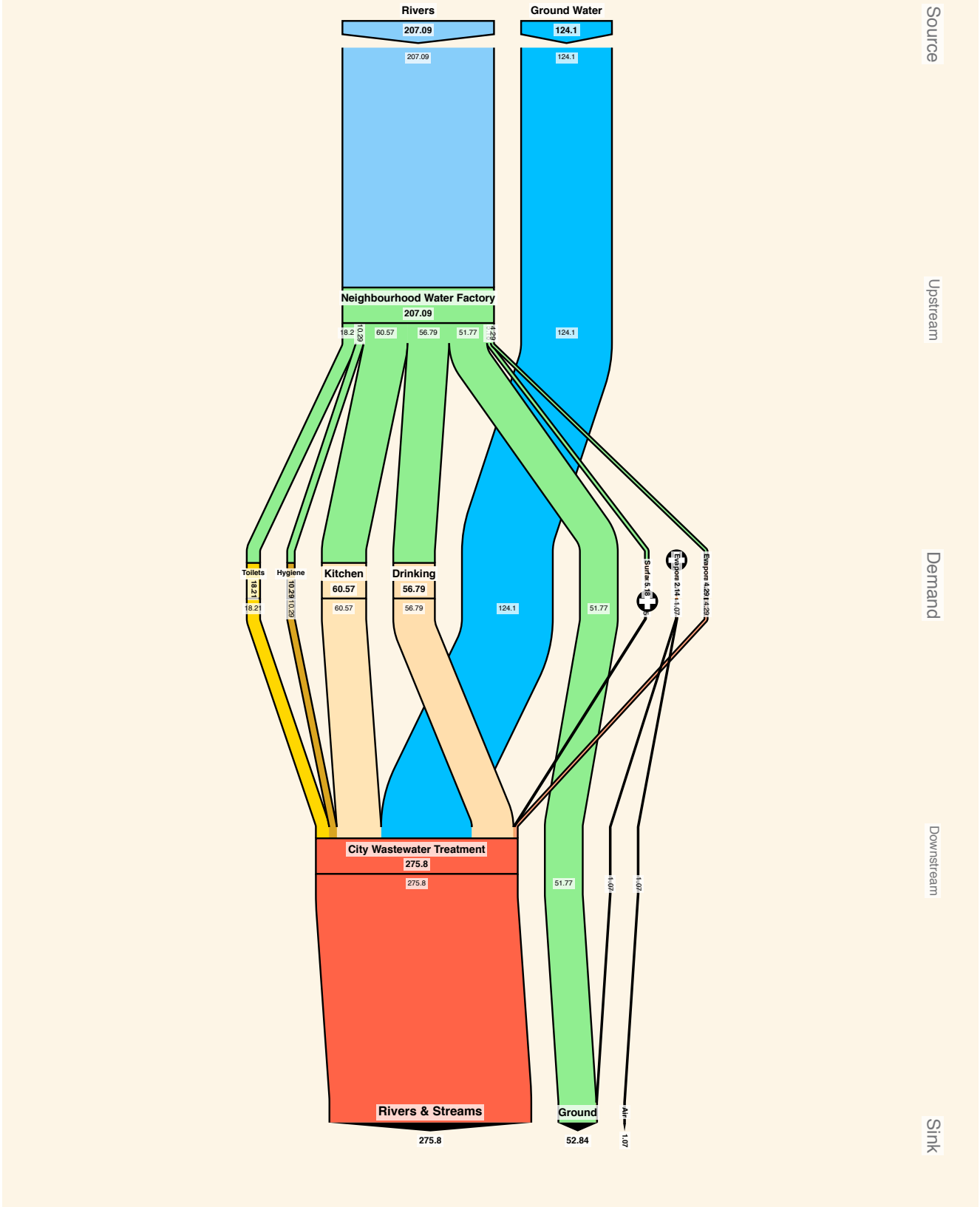
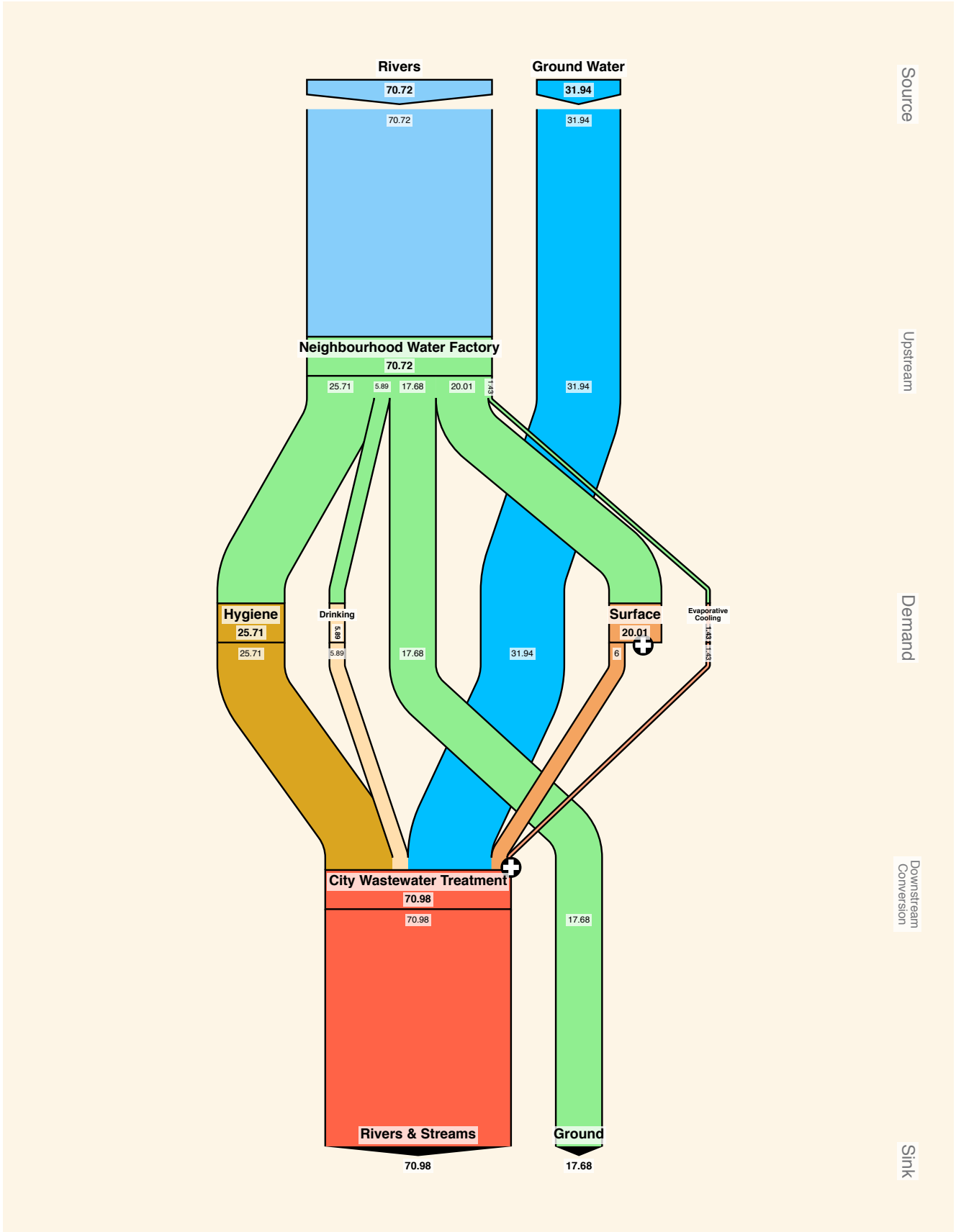
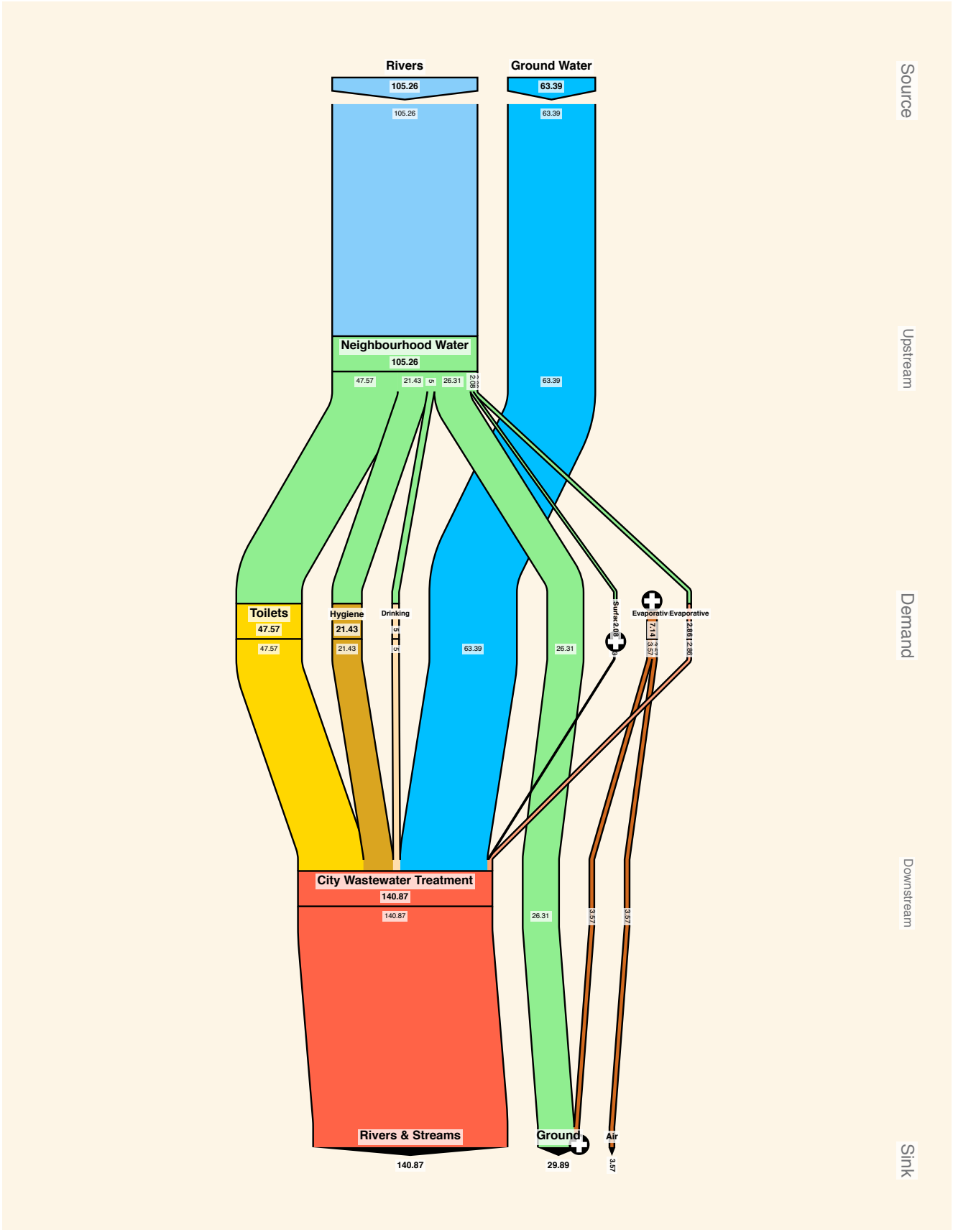


Commercial high water use



Commercial low water use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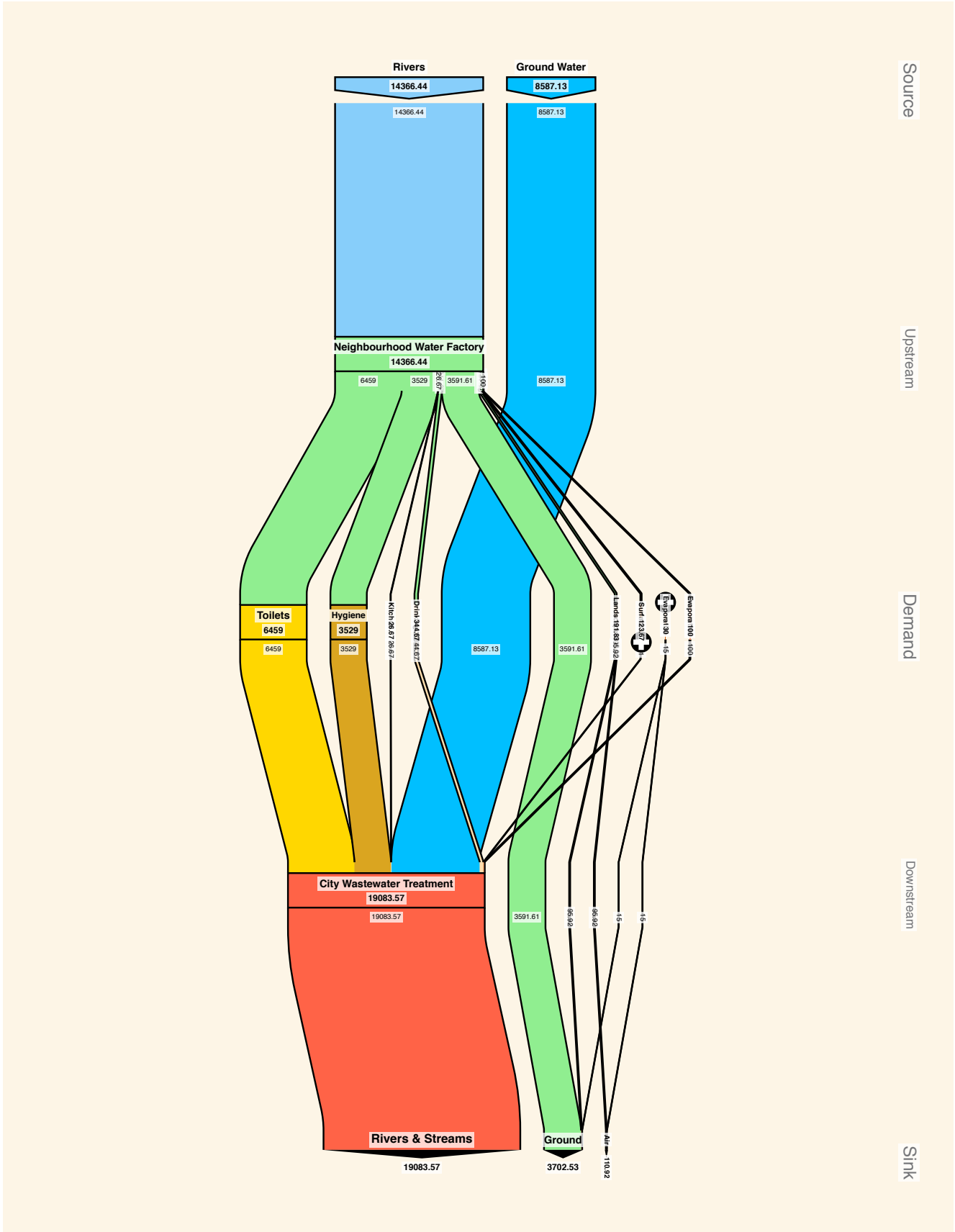
Upstream
Demand
Downstream
Sink
Rivers
105.26
Ground Water
63.39
Neighbourhood Water
105.26
Toilets
47.57
Hygiene
21.43
Drinking
City Wastewater Treatment
140.87
Rivers & Streams
140.87
Ground
29.89
Air
Evaporativ
Evaporative

Workshops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City Wastewater Treatment
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Ground
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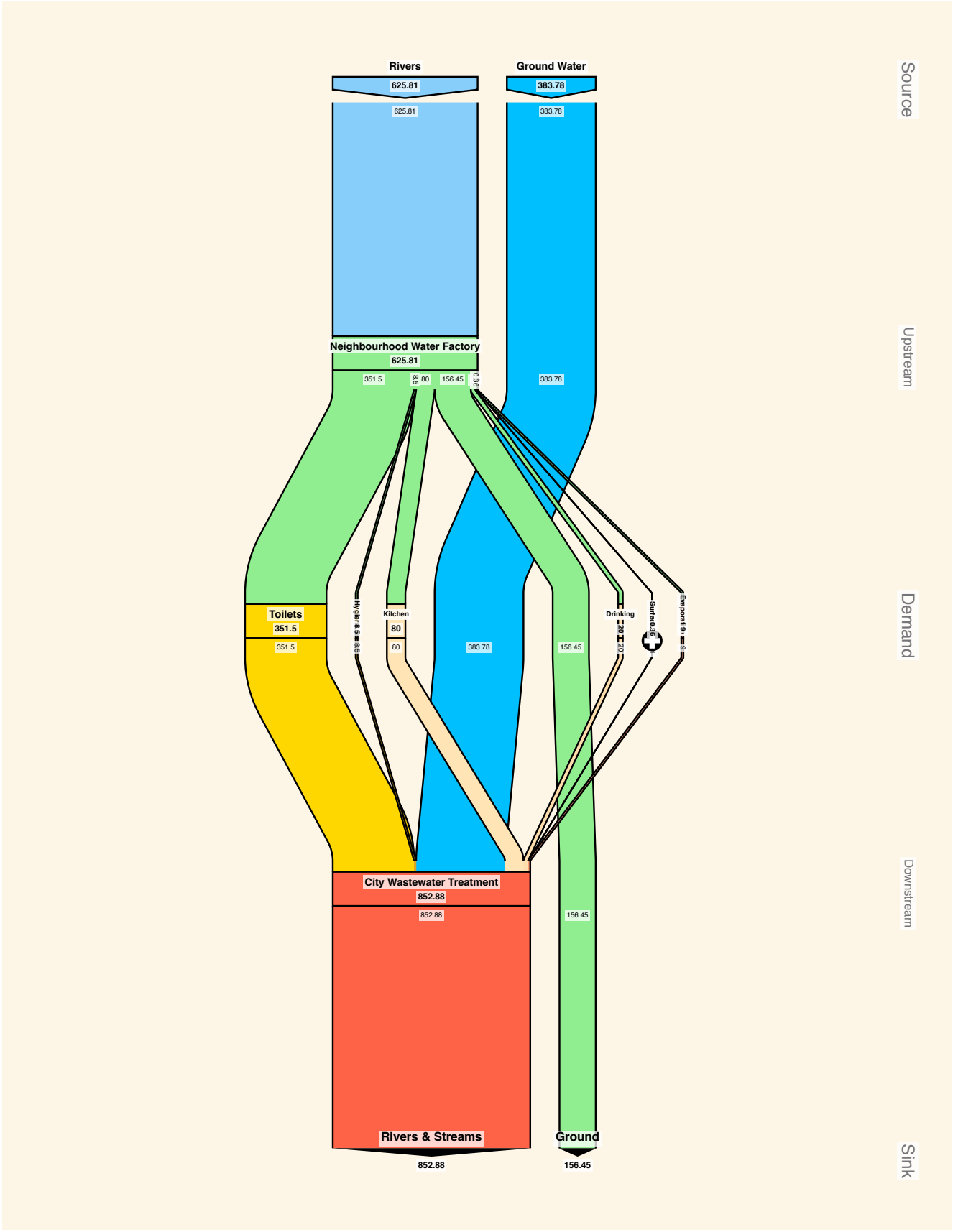
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8.5
80
156.45
0.36
383.78
Toilets
351.5
Kitchen
80
Hygiene 8.5
Drinking
20
Surface 0.36
Footpoint 9
City Wastewater Treatment
852.88
Rivers & Streams
852.88
Ground
156.45

Religious