SPRING DEVELOPMENT, WATER TREATMENT & DISTRIBUTION SYSTEM

AL NWAI'MAH, PALESTINE

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INTRODUCTION

The Palestinian water supply in the West Bank faces a structural deficit of more than 50 million cubic meters per year, which is expected to grow substantially in the coming decades. Additionally, approximately 65% of Palestinian wastewater is collected in cesspits or discharged directly into wadis (ephemeral streams).

The Al Nwai'mah Village, like many West Bank villages, does not receive a sufficient quantity of potable water. The current water source, a gravity spring, is not being utilized effectively and is in need of primary treatment. While the local council has replaced part of the existing domestic water distribution networks, there is still a need for a comprehensive project to supply water to the residential and industrial areas (including a mineral water bottling facility), and the Palestinian Police Training Center.

Al Nwai'mah, Palestine

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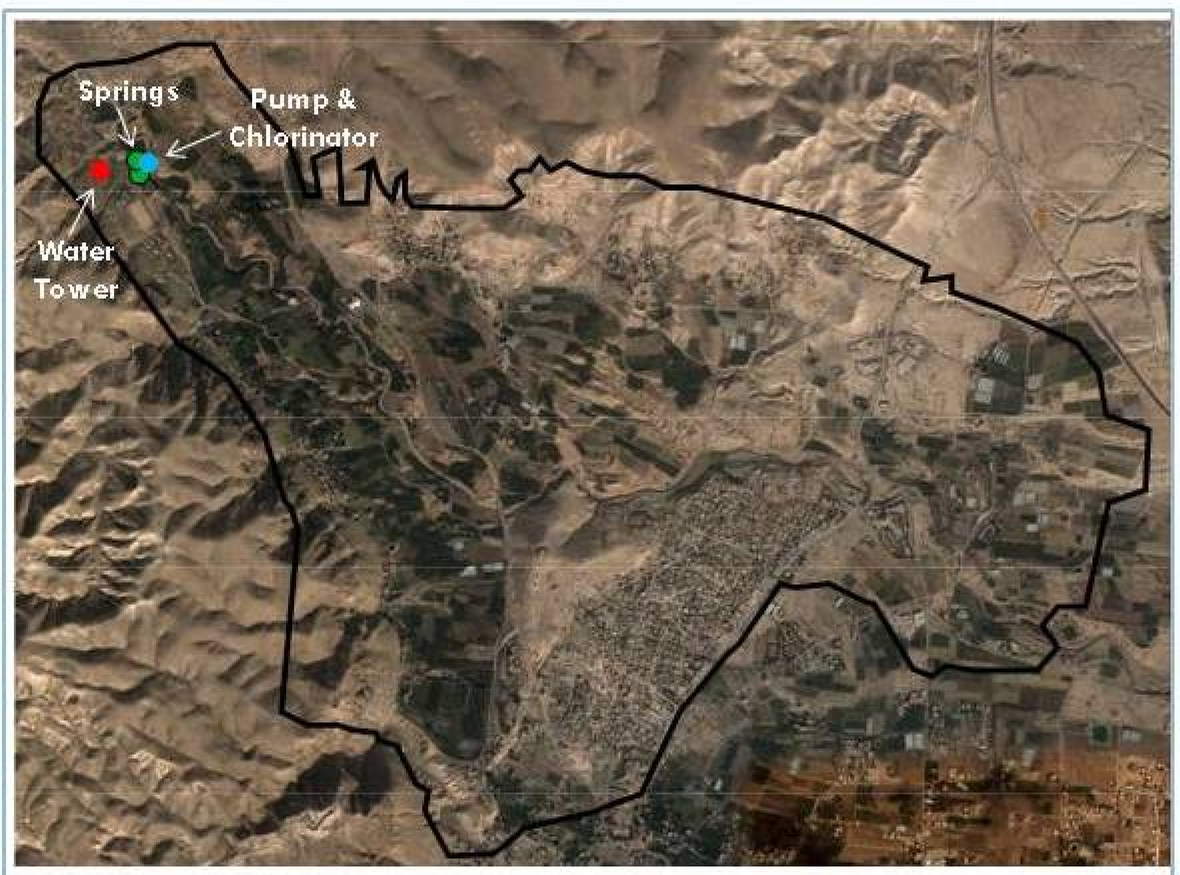
OBJECTIVES

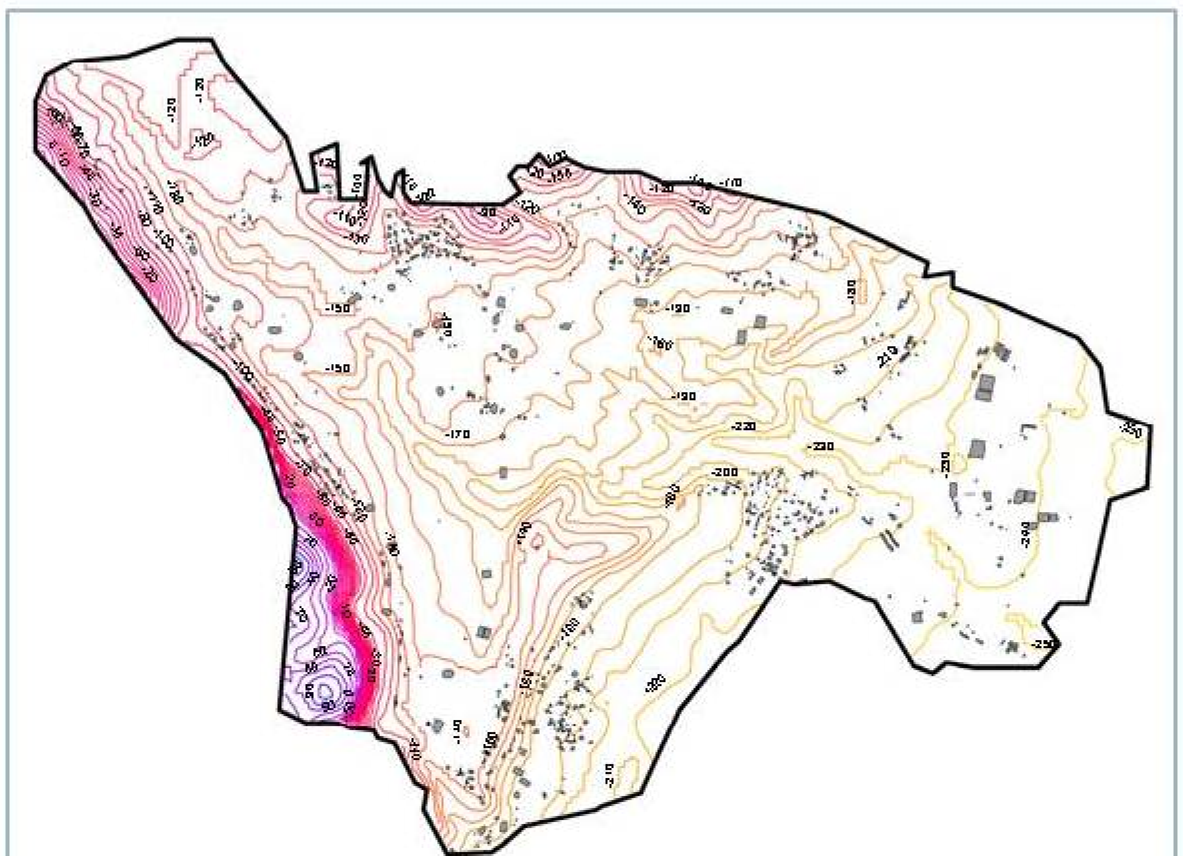
- Design a collection tank and elevated tank to collect and distribute water from the Al Nwai'mah and Al Duyuk springs to the Al Nwai'mah Village
- Disinfect and provide a residual to distributed water
- Design a water distribution network to satisfy the demand of the targeted area

LAYOUT

Targeted area: 842 hectares (2080 acres)

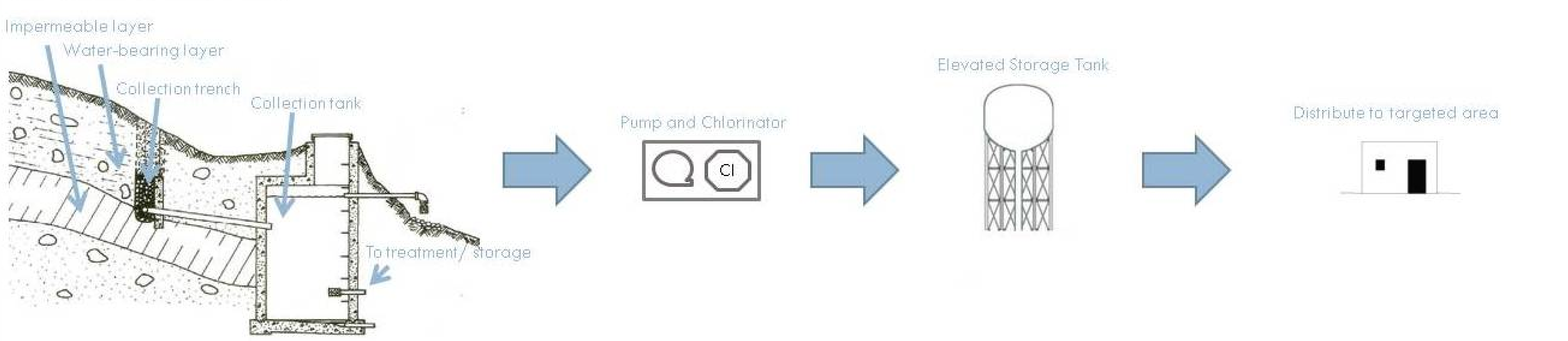


Study Area – Aerial view



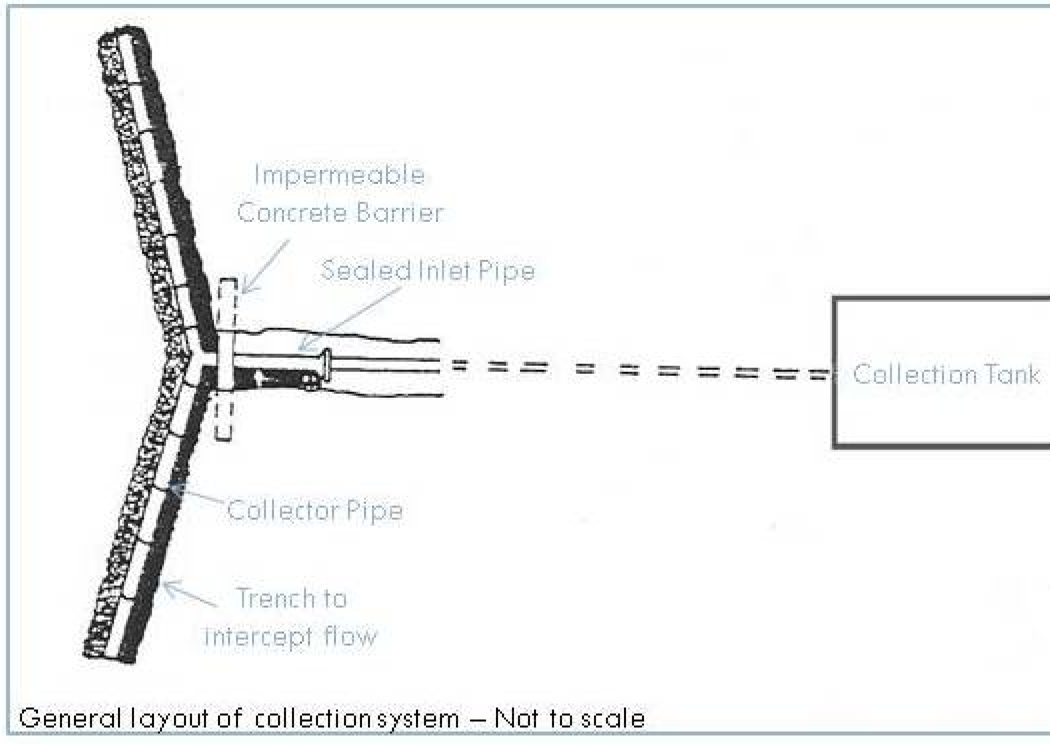
Study Area – Contoured at 10 meter intervals (structures in grey)

PROJECT OVERVIEW

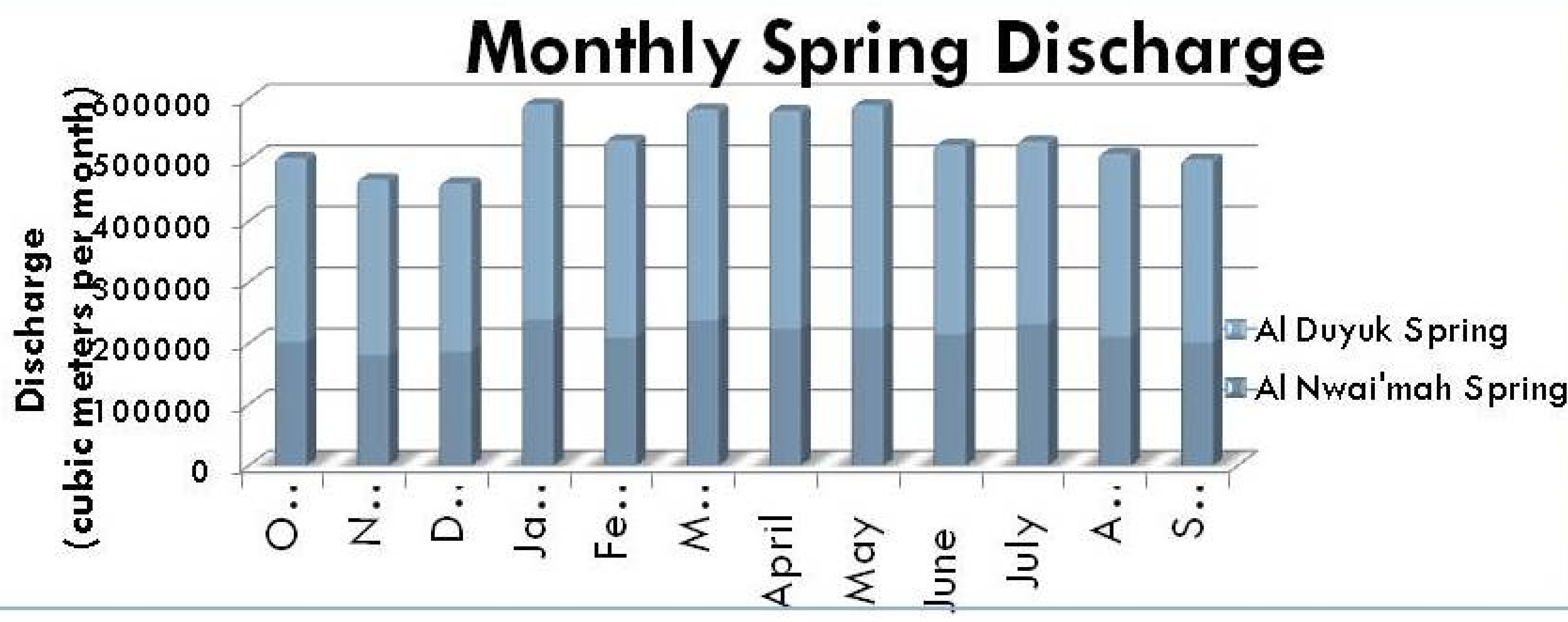


DESIGN CRITERIA FOR WATER COLLECTION

- At peak flow the system can collect 19,669 cubic meters per day.
- A 2 foot wide trench will be dug at the spring site to the depth of impervious layer. At this depth, perforated polyethylene pipe collection pipes will be laid, and surrounded by gravel and large aggregate. Over the aggregate layer will be a layer of filter fabric to prevent sediment from entering the collection pipe.
- In order to collect all the spring flow, a concrete wall will be installed into the soil past the impermeable layer to block the flow of water from the spring that is not immediately collected into the system.
- Once the water has entered the collection pipes, it will be transported into a collection tank.
- The collection tank will hold 3000 cubic meters of water. This water will be pumped from the tank through the disinfection process and into the storage tower.



General layout of collection system – Not to scale



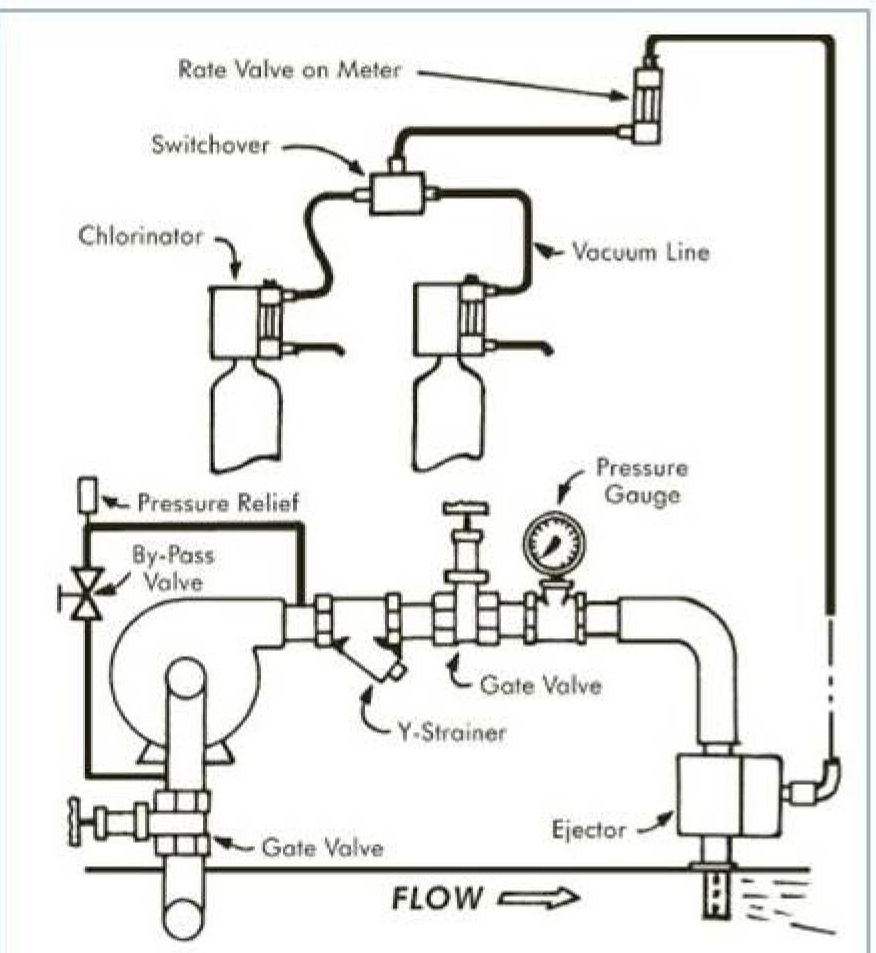

Current conditions at spring discharge location

SAFETY AND QUALITY STANDARDS

- Water quality issue: **Fecal coliforms**
- Preferable treatment method is chlorination.
- We recommend installing a **Gas Feed Injection Chlorinator** which is capable of outputting at least 63 pounds of chlorine gas per day.
- Chlorine dosage best determined with water sample from location
  - Palestine Hydrology Group will obtain water sample and determine exact dosage needed
  - We will provide a rough estimate (1-2 mg available Cl/L typical for bacteria inactivation)
- Attempting to remove more than 40 pounds of chlorine per day from a standard 150 pound chlorine cylinder may cause the tank to freeze. Therefore, we recommend a dual tank, automatic switchover system. (See figure below.)

		Al Nwai'mah	Al Duyuk	Allowable*
EC	S/m	0.07	0.0702	0.07
TDS	mg/L	375	376	1000
pH	--	7	8	6.5-8.5
Ca^{2+}	mg/L	95.9	98.7	100
Mg^{2+}	mg/L	13.6	11.4	50
Na^{+}	mg/L	21.5	21.5	200
K^{+}	mg/L	2.5	2.7	10
HCO_3^-	mg/L	288.2	285.2	--
SO_4^{2-}	mg/L	17.4	19.1	200
Cl^-	mg/L	45.1	44.1	250
NO_3^-	mg/L	35.1	35.3	50
PO_4^{3-}	mg/L	0.15	0.19	--
SiO_2	mg/L	15.4	15.8	--
F^-	mg/L	0.00005	0.00102	1-0.6
Fe	mg/L	0.024	0.051	0.3
Cu	mg/L	0.007	0.015	1
Mn	mg/L	0.001	0.003	0.1
Cd	mg/L	0	0	0.005
Zn	mg/L	0	0	5
Pb	mg/L	0.009	0.005	0.001
Total Coliforms	Colony/100mL	32	104	0
Fecal Coliforms	Colony/100mL	14	86	0-3

* Allowable by the water quality limits promulgated by the Palestinian Water Authority

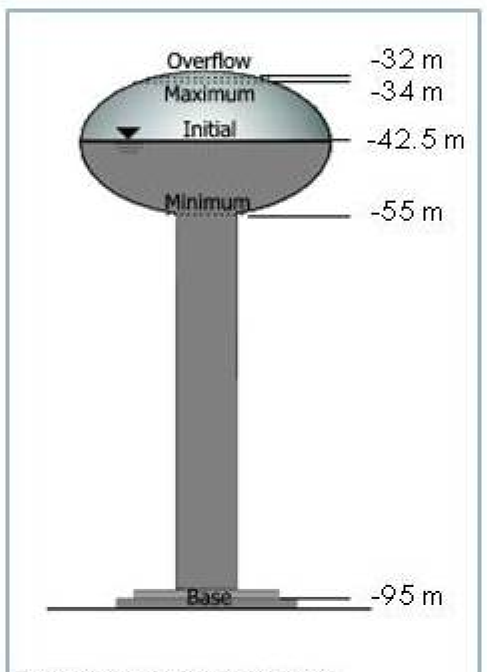


Global Treat, Inc.

Effects of Chlorination

- Combined chlorine disinfection is preferred to avoid trihalomethane (THM) formation, however this process is more difficult to employ.
- When chlorine is first added to the water, it reacts with the dissolved inorganic or organic substances and is then unavailable for disinfection. The amount of chlorine used in this initial process is the chlorine demand. The interaction between organic substances and chlorine produces THMs which are known to cause cancer.
- Testing should be conducted quarterly to monitor total trihalomethane (TTHM) levels, the maximum residual disinfectant level (MRDL), and the levels of the five haloacetic acids (HAA5).
- TTHM monitoring results may indicate the need for additional treatment to include the best available technology for reduction of disinfection by-products (DBPs).
- Safety precautions should be observed when working with or around chlorine. These precautions include, but are not limited to: avoiding the use of an open flame near chlorination equipment, dawning a self-contained breathing apparatus when changing tanks in case of accidental release, and installing exhaust air ducts at floor level where chlorination equipment is kept.

ELEVATED STORAGE TOWER SPECIFICATIONS

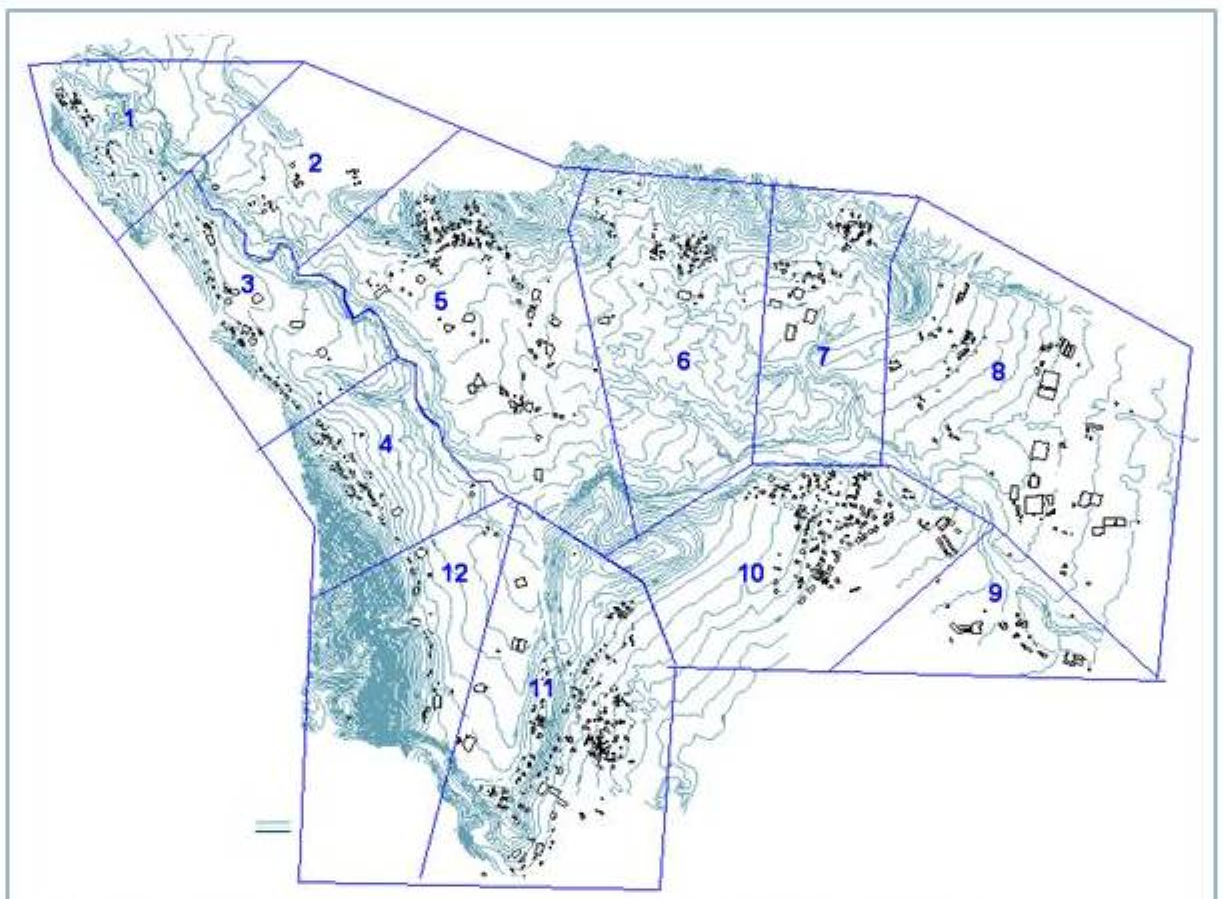


Storage tower elevations

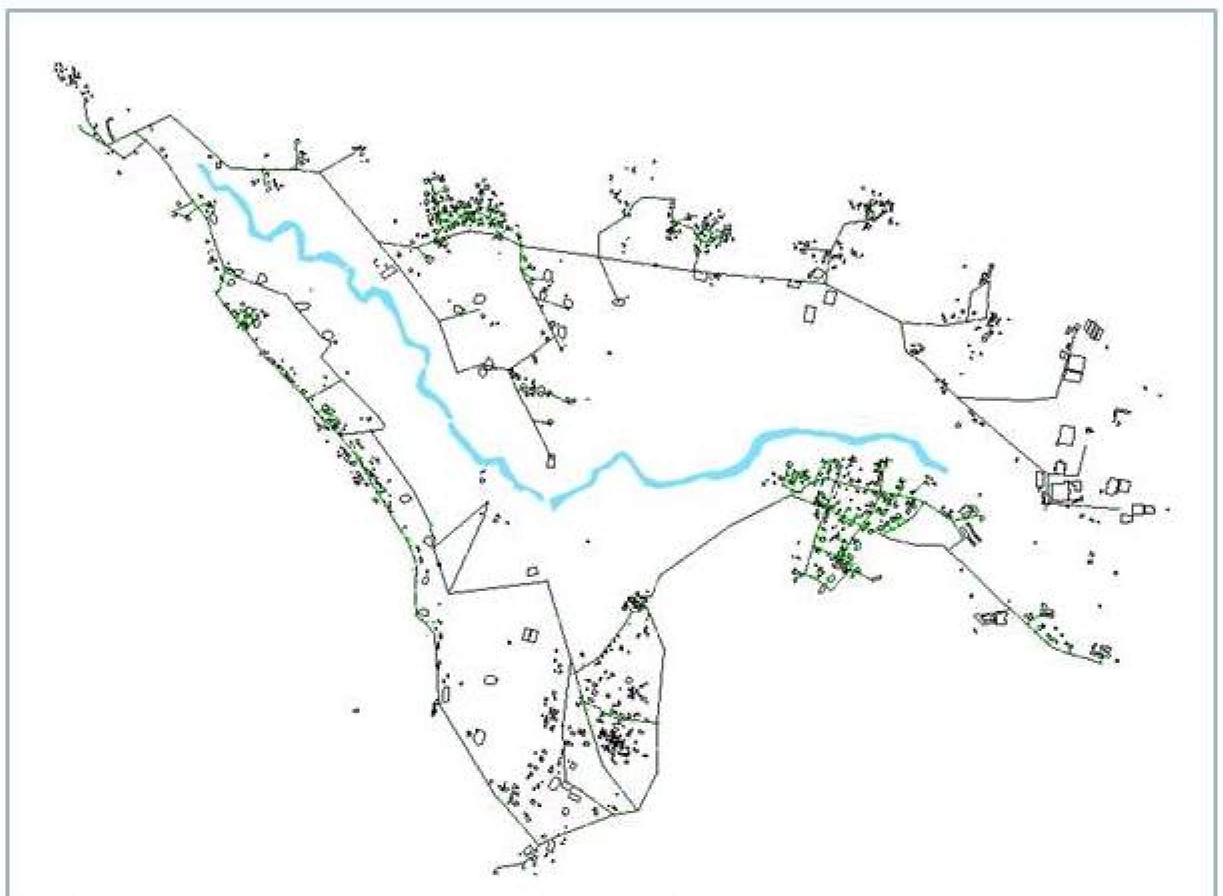
- The tank is elevated to provide hydrostatic pressure.
- The tank is designed to hold one day's worth of water which is 9 million liters. In the event of power/pump failure the system will continue to run for 24 hours.
- The volume between the minimum and maximum elevations allow for this 9 million liter volume. At two meters above the maximum elevation there is an alarm after which two more meters may be filled before reaching the tank roof.
- The location provides elevation while still being close to the spring.
- The tank will be constructed using reinforced concrete. Reinforced concrete resists compression and bending, and is easily acquired in the area.

DISTRIBUTION

- This project requires water to be provided to each structure greater than 90 square meters and to recharge each pond used for irrigation.
- There are 394 structures and 37 ponds requiring delivery of water.
- The pressure at each node (location of water delivery) is to be between 2 and 7 bars (29 to 101.5 pounds per square inch).
- Pressure reducing valves were placed strategically throughout the system to maintain the required pressure range.
- Galvanized steel pipe is to be used throughout the network, with shut off valves and flow meters at every demand node, and fire hydrants approximately every kilometer.
- It is assumed that the demand for this area is 145 liters per capita-day.
- Total demand is calculated to be 9,041,098 liters per day. This includes demand of the population and irrigation needs.
- For the purpose of design, the target area is split into 12 zones based upon population clusters.
- Each zone is modeled separately in WaterCAD to calculate the demand, lay out the pipe network, and identify trouble spots.
- Individual zones are combined into one file and modeled together to determine pipe sizes and residence time of the water in the pipes.



Al Nwai'mah – 5 foot contour map, with zone delineation, houses, and ponds


Al Nwai'mah – Distribution network, with houses, ponds, and stream

RESULTS

Parts of our design, namely the depth of the collection trench and chlorine dosage, have been left to be determined in the field. Other portions of the design may need to be modified to take into consideration variations from the documentation initially provided. We will provide the Palestinian Hydrology Group with methodology for determining these values.

Through completion and delivery of this project to the Palestinian Hydrology Group, we will provide this community with a sufficient quantity of potable water to satisfy their needs for personal consumption and irrigation uses. Overcoming a water deficit and providing water to arid regions has always been, and will continue to be a major problem. Meeting the demands of this region may increase economic development and reduce the potential for disease. Additionally, we hope to improve American perceptions of Palestine and the Middle East and vice versa.

ACKNOWLEDGEMENTS

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