The Decapolis: History and Archaeology

8 Archaeology of the Roman period IV – Water facilities

http://www.romanaqueducts.info/index.html

Water facilities

- Water supply – aqueducts, cisterns
- Bathing – bathhouses, medicinal spas

- Spring-fed x rain-fed (run-off) water supply
- Water management becomes crucial in the Mediterranean climate with clear distinction between rainy (winter) and dry season (see lecture 1 Introduction)
- Due to the seasonal weather pattern many springs are also only seasonal (aquifers that are filled only by rains)
- I.e. perennial springs used for water supply wherever possible (mainly cities)
- Rain-fed water supply predominantly used in marginal areas – for both human consumption and irrigation
- Cisterns for long-term storage

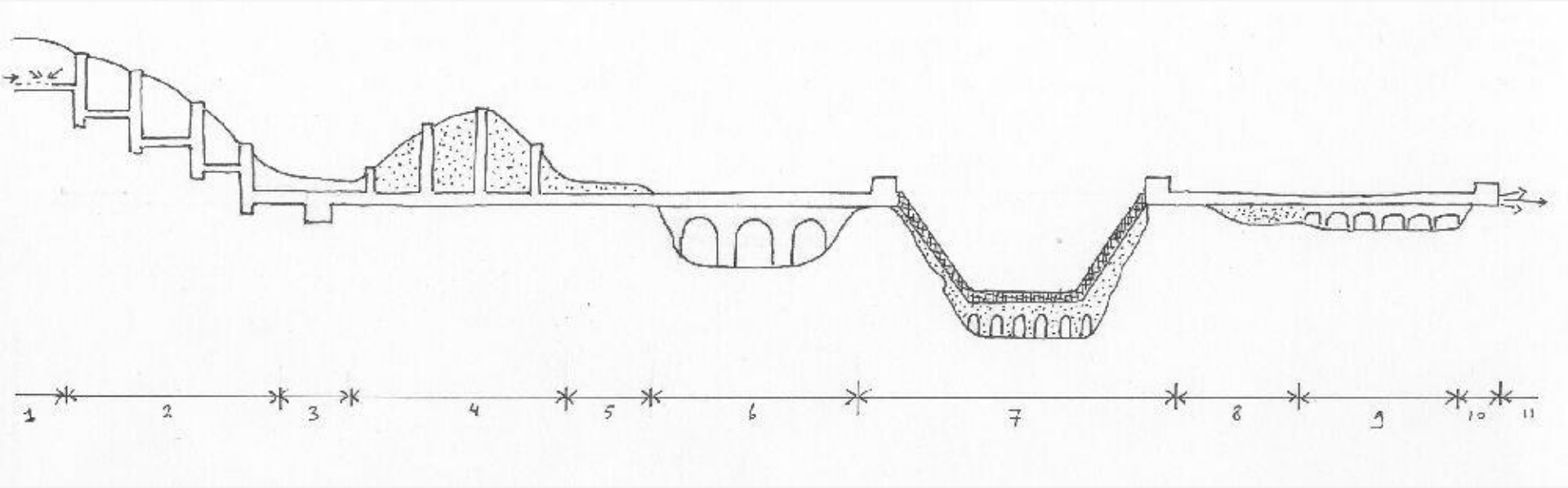
Summer and winter in the southern Golan Heights (~450-500 mm of rain/year; comp. Prague ca. 520 mm/year)

Water facilities

Aqueducts

- Rock-cut conduits, dams and cisterns start to appear in the Levant at least during the Bronze age
- Hellenistic and Roman engineering brings new technological development

"There are three methods of conducting water, in **channels through masonry conduits, or in lead pipes, or in pipes of baked clay**. If in conduits, let the masonry be as solid as possible, and let the bed of the channel have a gradient of not less than a quarter of an inch for every hundred feet [i.e. 0.5 %], and **let the masonry structure be arched over**, so that the sun may not strike the water at all. **When it has reached the city, build a reservoir with a distribution tank in three compartments connected with the reservoir to receive the water**, and let the reservoir have three pipes, one for each of the connecting tanks, so that when the water runs over from the tanks at the ends, it may run into the one between them." Vitruvius 8.6.1



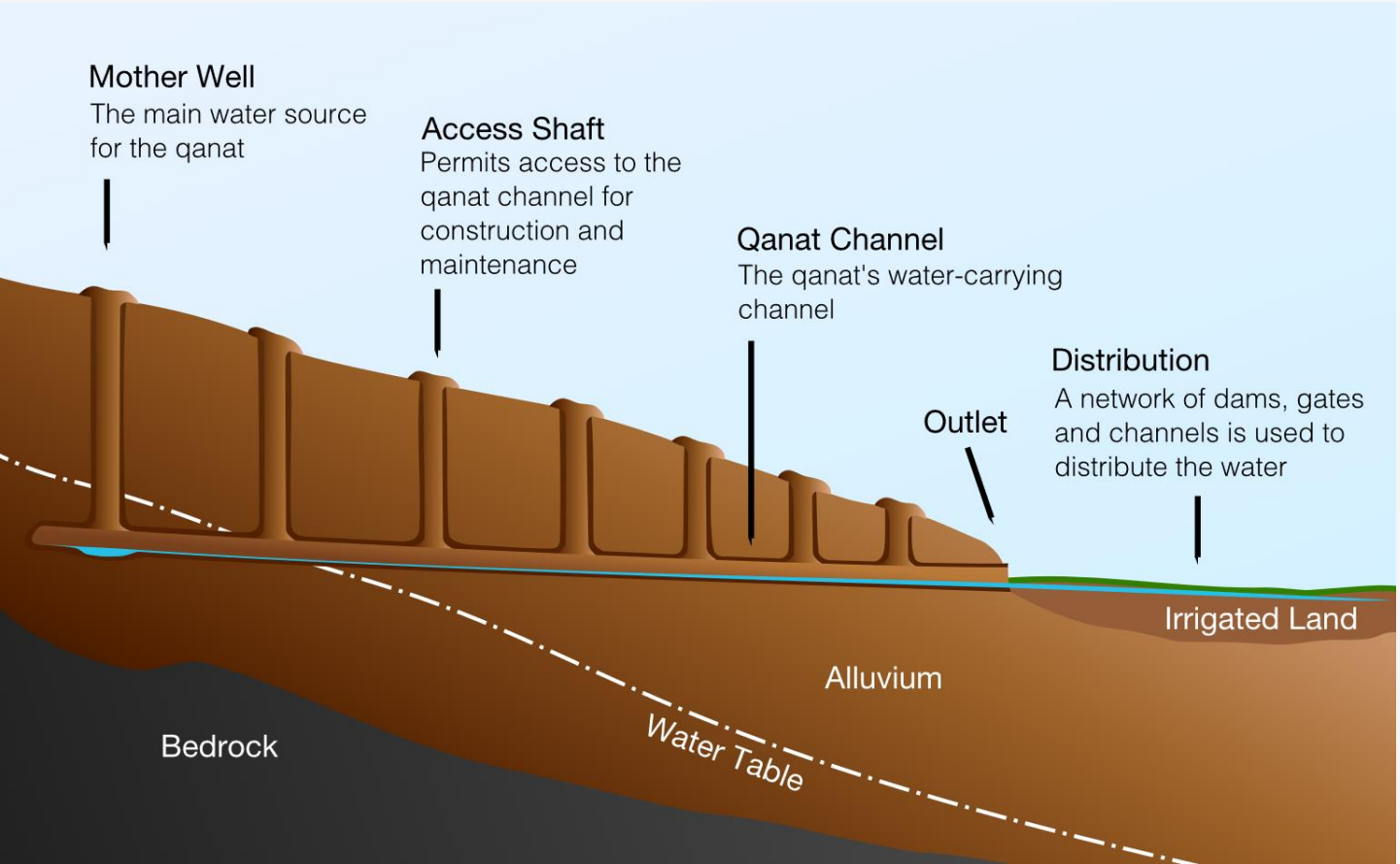
1. source
2. steep chutes (traversing steep slopes)
3. settling tank (separation of impurities in the water)
4. tunnel and shafts (*putei*)
5. covered trench
6. aqueduct bridge
7. (inverted) siphon
8. substruction
9. arcade
10. distribution basin (*castellum*)
11. water distribution (pipes – terracotta, lead, stone…; etc.)

Water facilities

Qanat

- Also *kariz*
- Originating in the 1st millenium BCE in the area of Persian Gulf – typical of arid regions
- A method of bringing water from the aquifers in long subterranean channel, characterized by access shafts in regular intervals

Right: access shafts seen from space, Gonabad, Iran

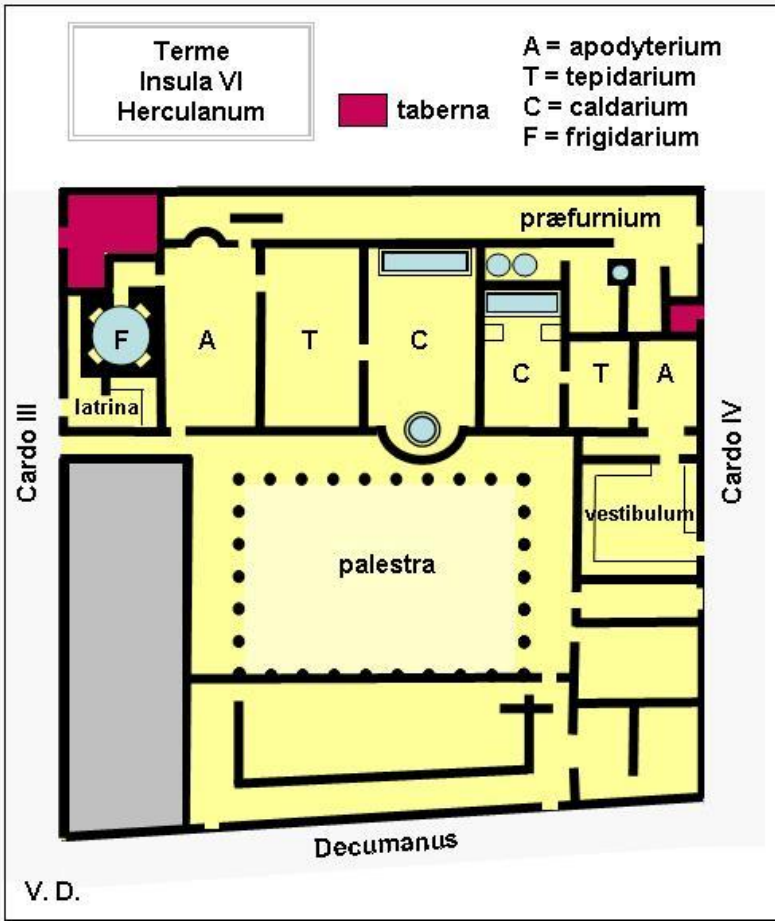


Water facilities

Baths

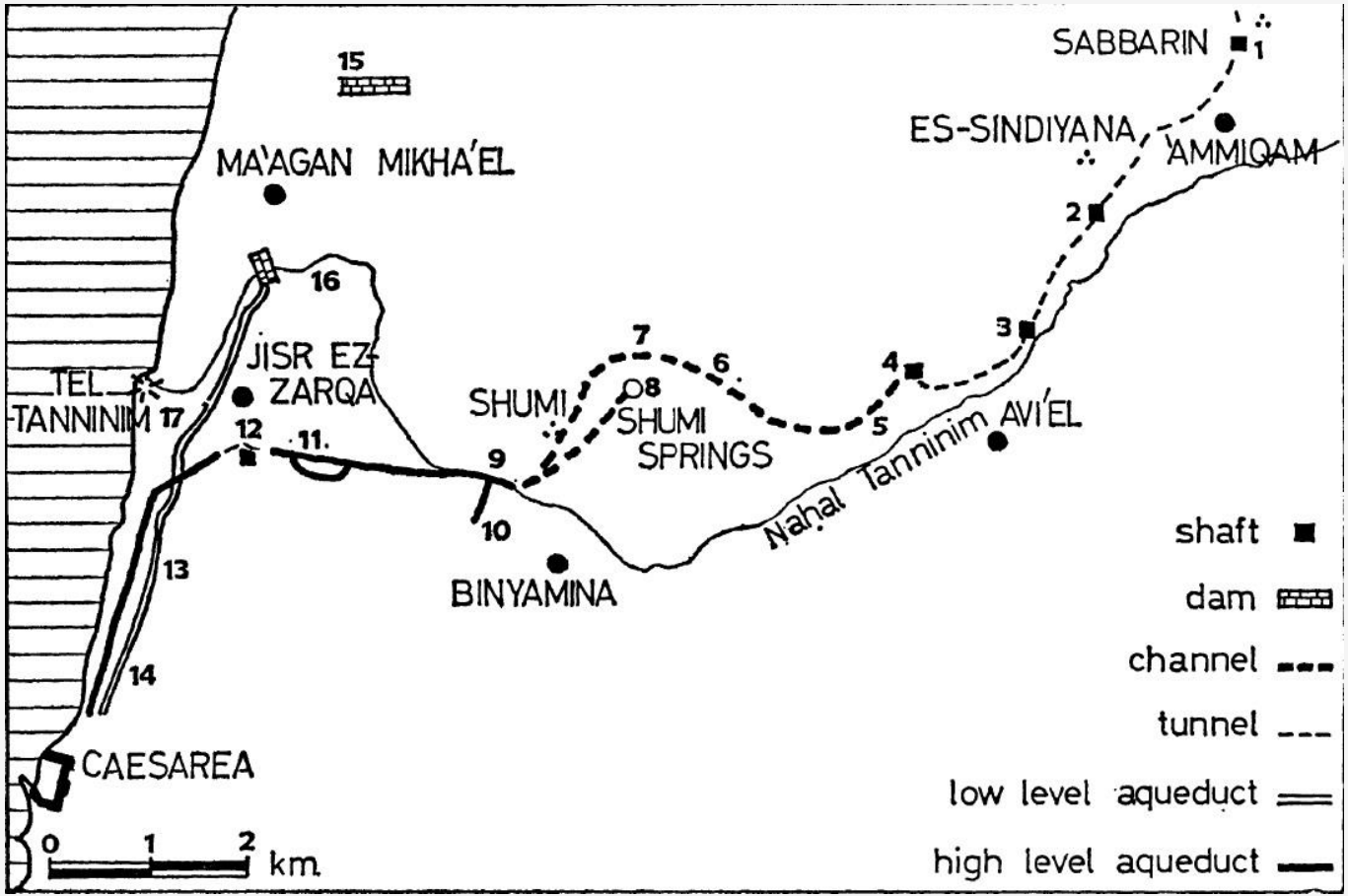
- Gr. *balaneia*, Lat. *thermae*
- Hygienic, social, cultural and medical institution
- "Greek type" – using bathtubs
- "Roman type" – using pools of water of different temperature in separate rooms
- "Jewish-Greek"/"Judaean-Hellenistic" – combining features of Jewish ritual baths (*mikwa'ot*) and Greek bathtubs, confined mostly to the Hasmonaean/Early Herodian contexts
- Like many other things, Roman-style baths are introduced to the Levant by Herod

Below: stone bathtub from the Herodian palace at Cyprus (Israel, not the island). Left: schematic plan of Roman bathhouse with a typical "row" layout (the baths' rooms are arranged in one row) and a peristyle courtyard (*palaestra*) for exercises. Also note a divided male/female part (not so common; Herculaneum, Italy)



Caesarea

- Three aqueducts, combining natural springs in the Carmel Mts. and a river-fed reservoir on the lower Nahal Taninim
- Utilization of rock-cut tunnels, built channels and arched arcades
- High-level aq. (on arches before reaching the city)
- Low-level aq. (channel)
- Channel A (high-level aq.) – Herodian
- Channel B (high-level aq.) – first half of the 1st c. CE (Hadrianic)
- Low-level aq. – 4th/5th c. CE



Caesarea

High-level aq.

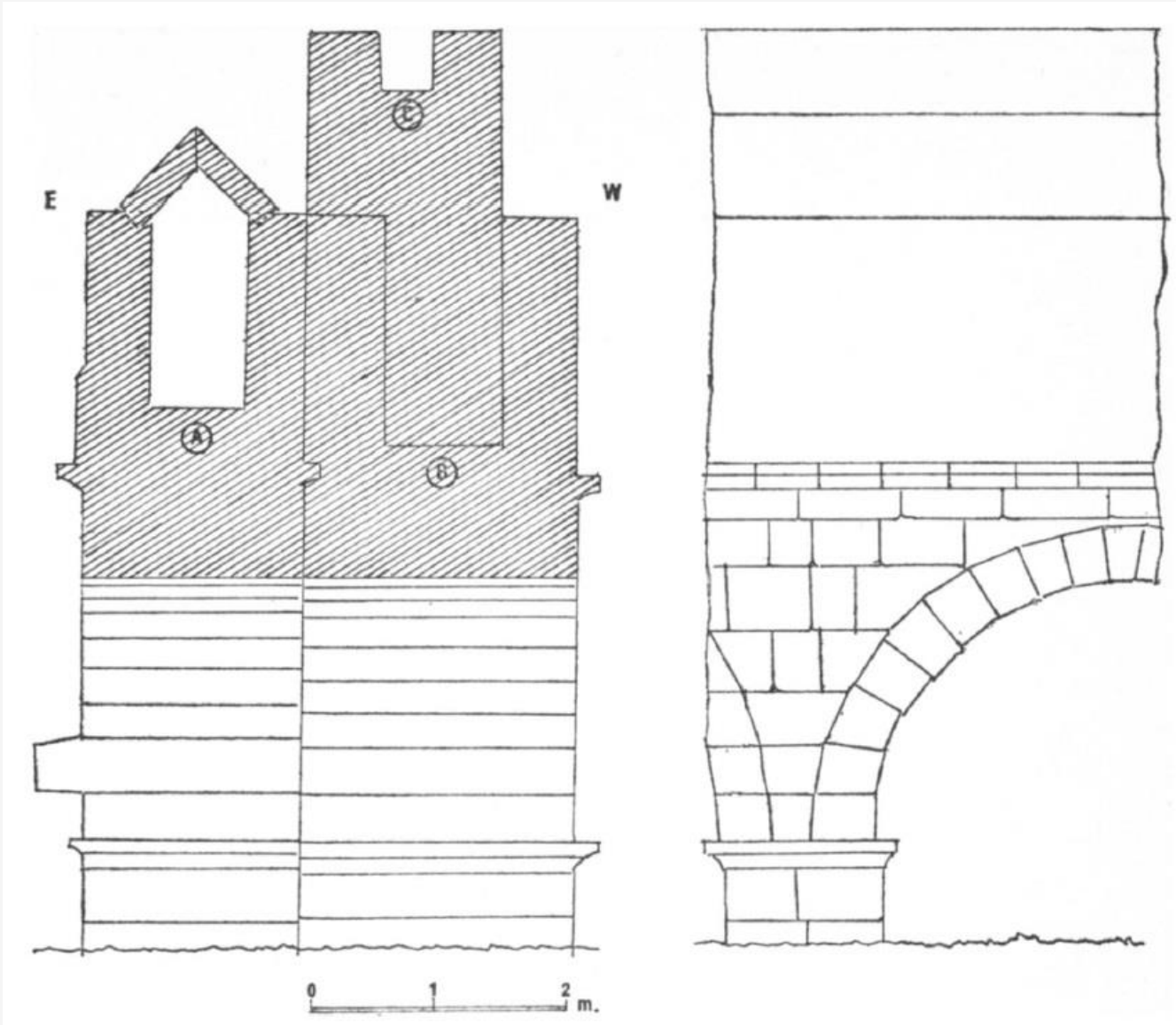
- Channel A brings water from the Shuni springs (see previous presentation), later perhaps from En Tzur as well (up to 900 m^3/hour)
- Channel B collects water from additional sources further to the north-east (up to 1,600 m^3/hour)

High-water aq. on the beach north of the city

Caesarea

High-level aq.

- Channel A
- Channel B – note how it is built against the western face of the channel A
- Channel C – later Byzantine addition, with much smaller capacity than channel B which it replaces



Caesarea

High-level aq.

- Two different construction phases are visible in the arches (channel A in the foreground)

Caesarea

High-level aq.

- Building inscription in *tabula ansata* of the Leg X Fretensis on the channel B aq.
- Note the additional reinforcement of the arches and weathering of the *kurkar* masonry

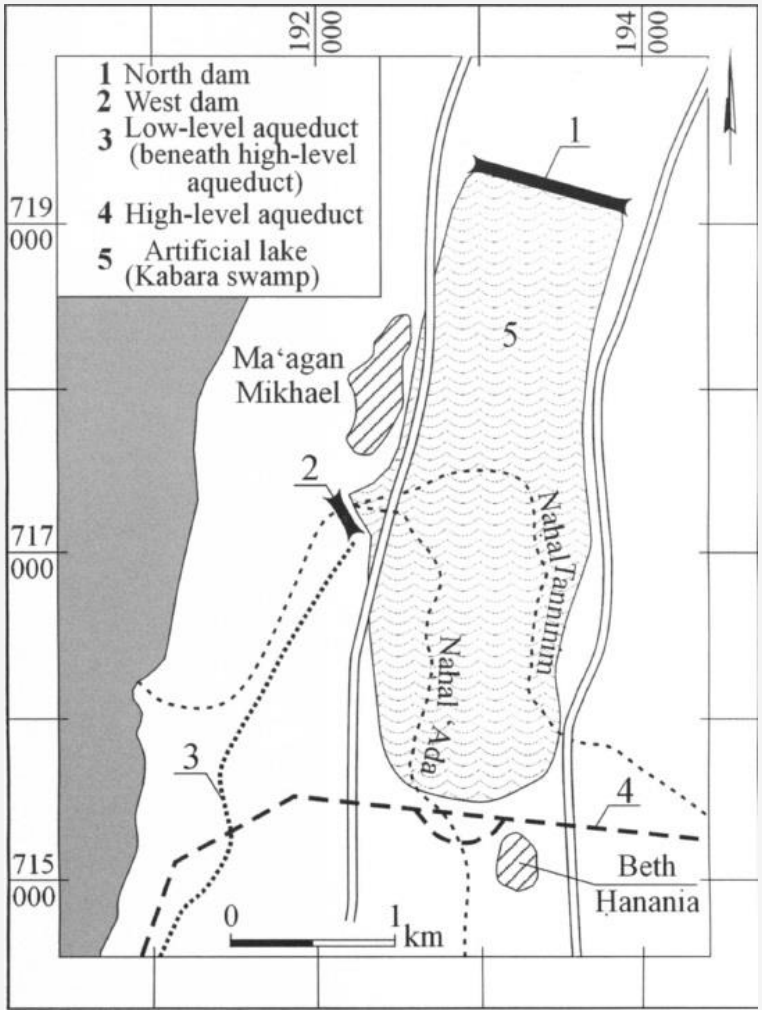
IMP TRAIANO
HADRIANO AVG
VEXILLATIO
LEG X FRET

Imp (eratori) Traiano
Hadriano Aug(usto)
vexillatio
leg(ionis) X Fret(ensis)

Caesarea

Low-level aq.

- Water reservoir was created by building a dam across Nahal Taninim, flooding Kabara swamps
- The reservoir covers ca. 5-6 km^2
- Marshes (now re-cultivated) are ca. 2 m below Caesarea and so the reservoir must be raised

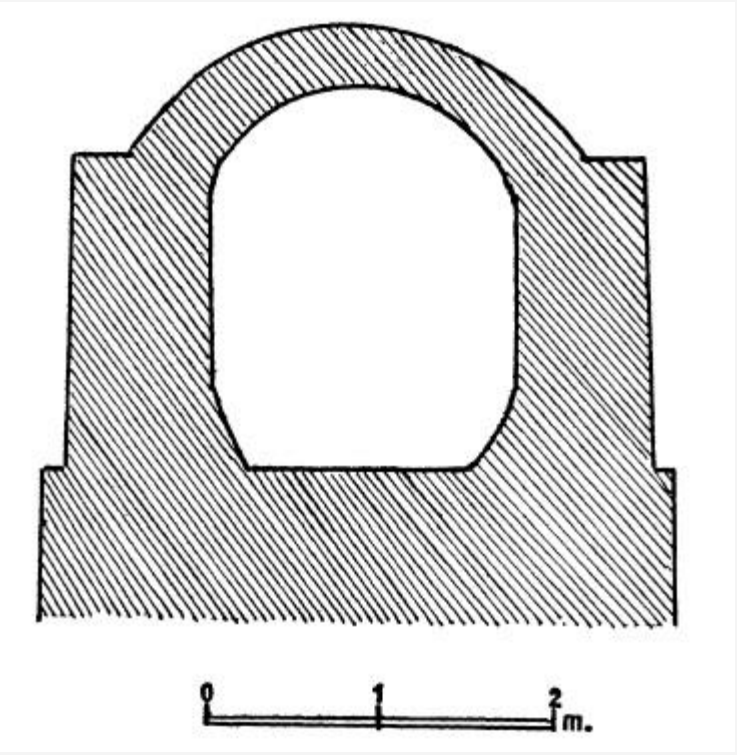


Caesarea

Low-level aq.

- Starts as a rock-hewn channel
- After ca. 1,350 m it changes into masonry built conduit
- Several branches with terracotta pipes were built in Antiquity

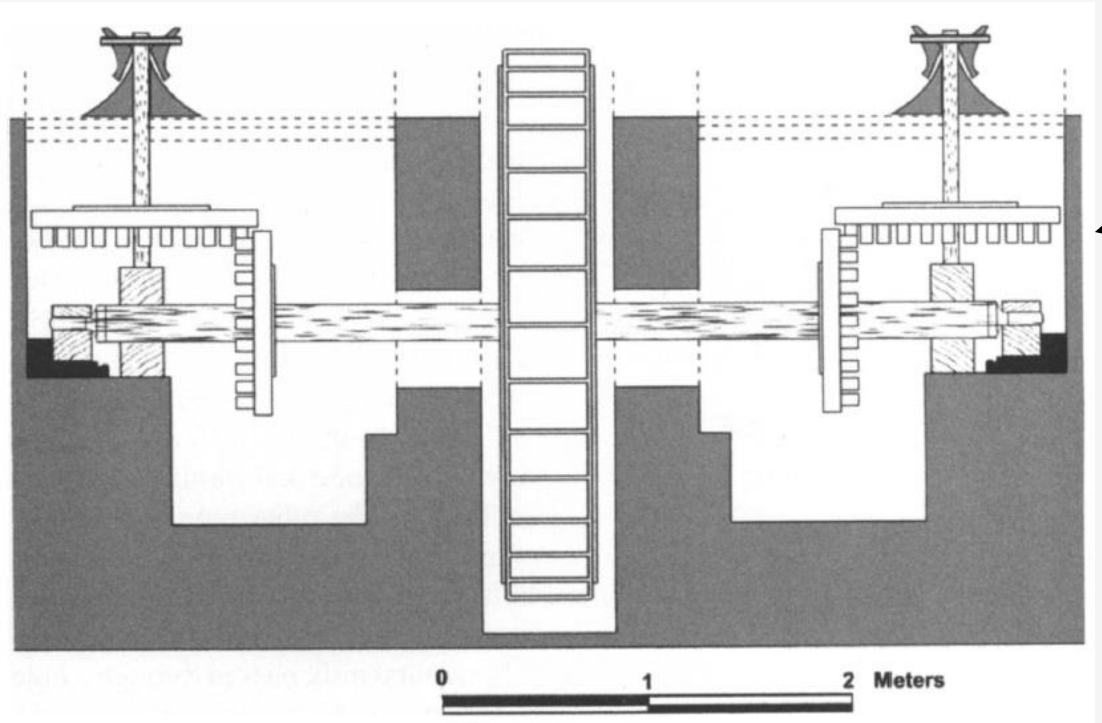
Water conduit on the beach north of the Caesarea

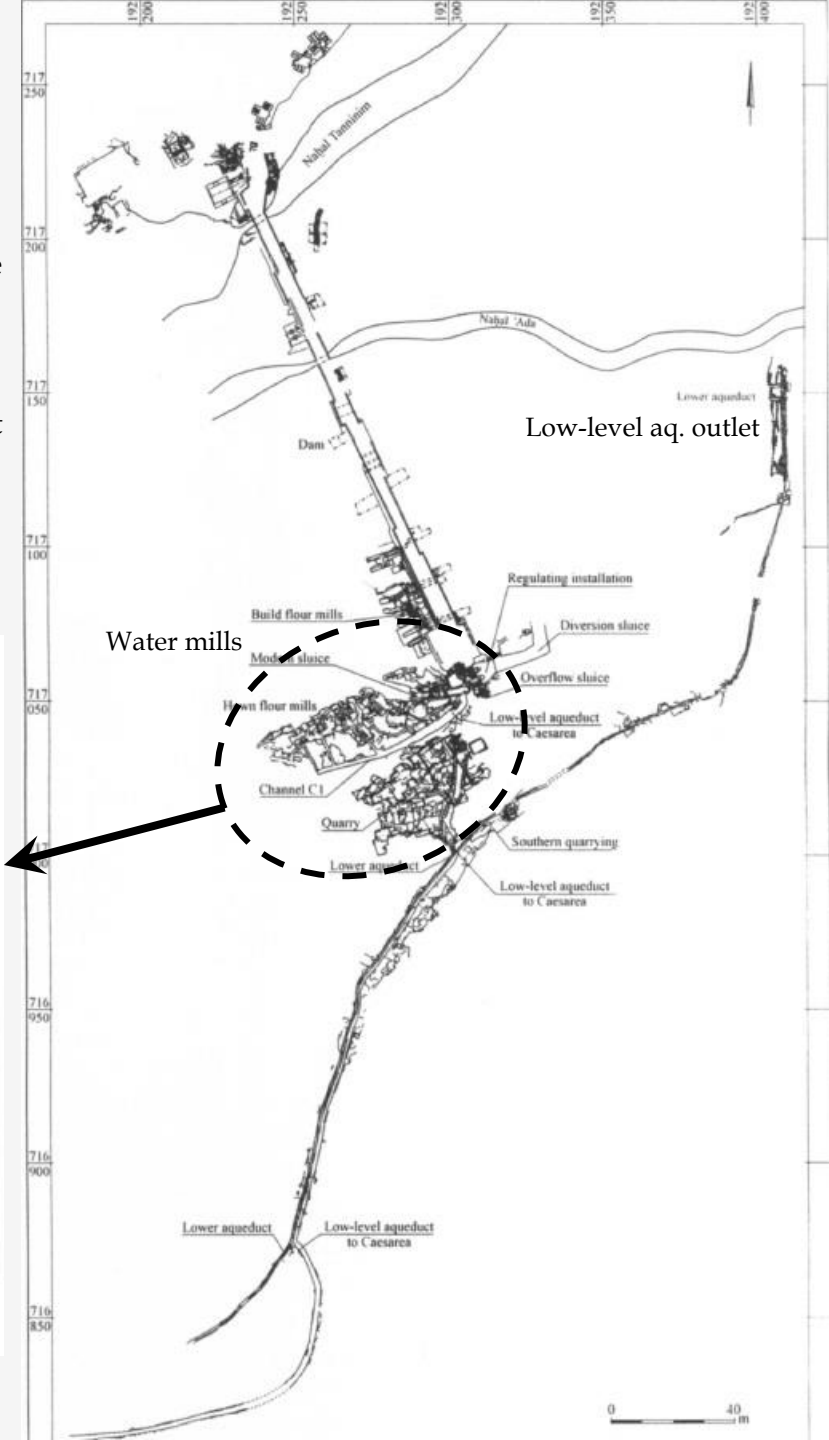


Caesarea

Low-level aq.

- At the outlet of the low-level aq. few sluices were built to accommodate water mills using Pompeian type millstones
- The dam served as a river crossing until modern times
- Several water mills were in existence by the western dam until 1920 (not the same as the Late Roman/Byzantine mills)

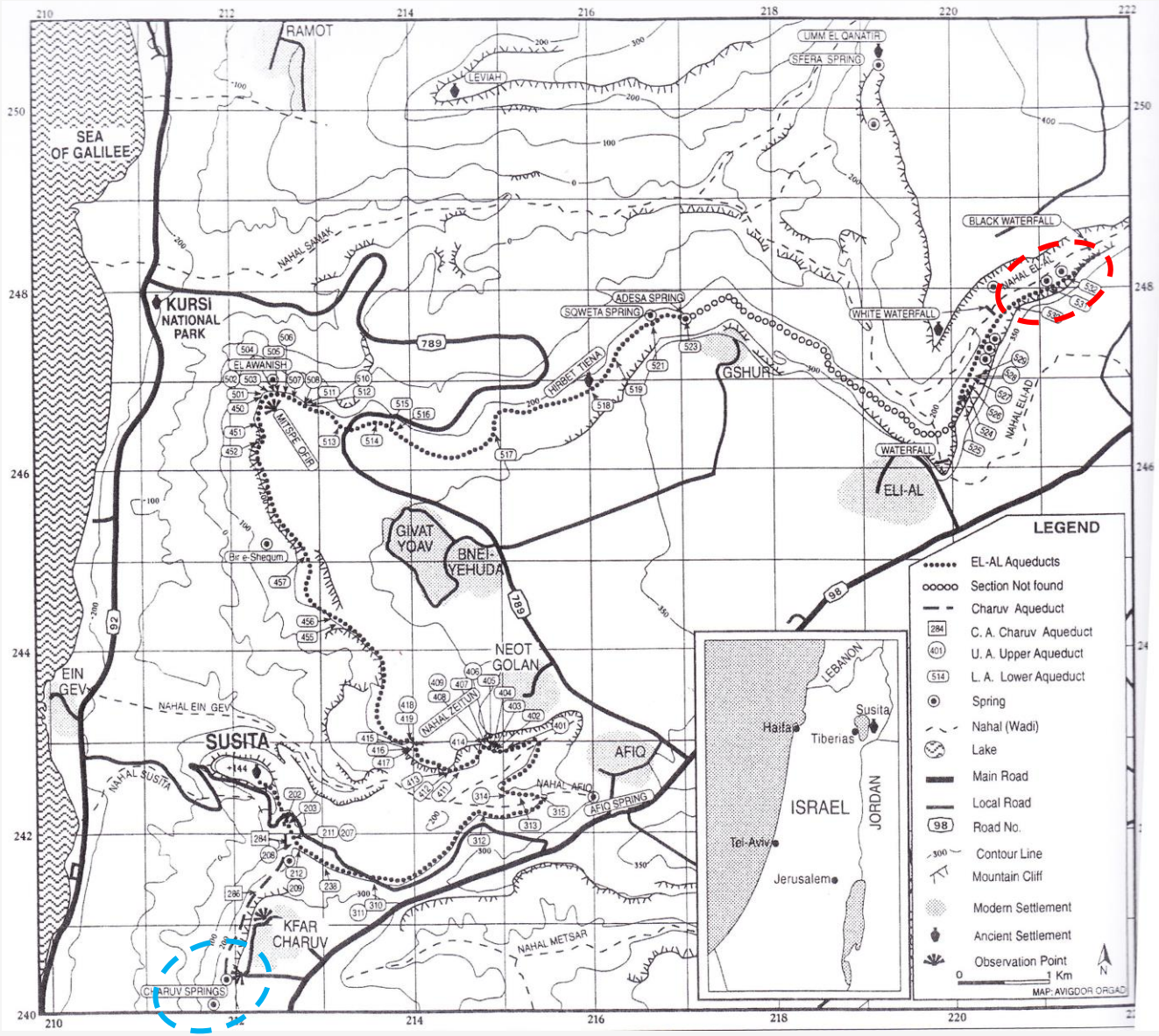




Hippos - aqueduct

- Three aqueducts
- Older (1st c. BCE?) and shorter (ca. 4 km) bringing water from nearby Haruv springs south of Hippos (in blue, low yield however)
- Upper and lower aqueducts (1st/2nd c. CE) both bringing water from the Black Waterfall springs in upper Nahal 'El 'Al valley (in red)
- The two channels are partially carved and partially built above one another and following contour lines (ca. 24 km in length)
- All three aqs. are brought to the city through a siphon made of stone pipeline

- Black Waterfall springs can supply ca. 150 m^3 of water/hour



Hippos - aqueduct

- Stone pipeline below the pavement of decumanus maximus just west of the eastern gate

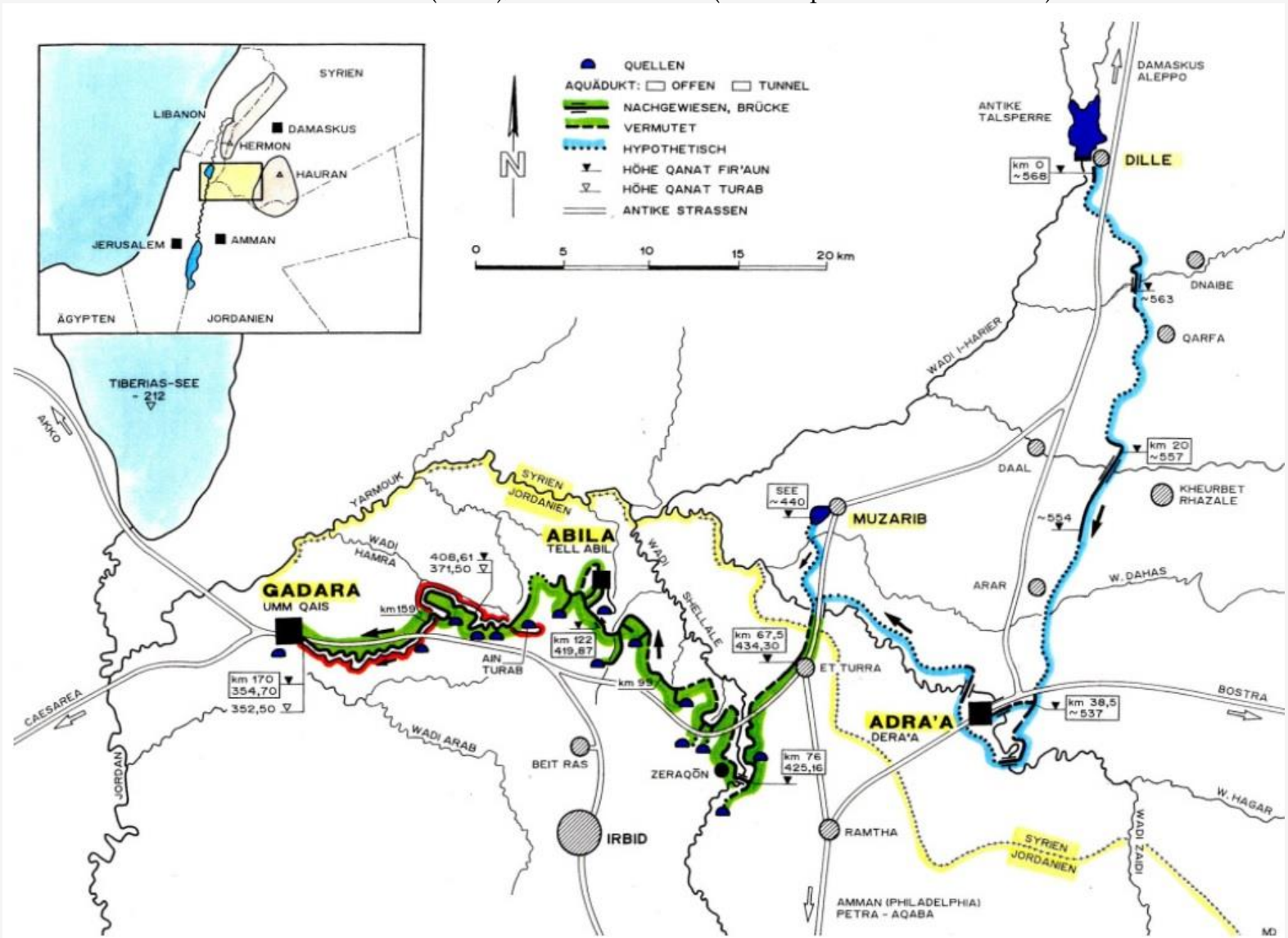
Terminus of stone pipeline and beginning of the masonry channel

Hippos - aqueduct

- Central water cistern for the city, below the agora/forum
- Hewn in the bedrock, vaulted roof directly below the pavement of the agora
- Plastered walls
- Ca. 1,200 m^3

Qanat Fira'un

- Probably the most impressive feat of the Roman engineering in the Eastern provinces, attesting how much effort and expense was dedicated to the water supply in Antiquity
- Ii is 100+ km long aqueduct comprising of masonry channels, bridges and rock-hewn channels
- It connects several ancient cities –Adraha (Deraʿ), Abila and Gadara (and Neapolis - Sheikh Miskin?)



Qanat Fira'un

- It begins at the marshes north of village e-Dille on upper Wadi el-Harir
- By erecting a dam a water reservoir (up to 3.5 km^2) was created in similar way as in Kebara marshes north of Caesarea

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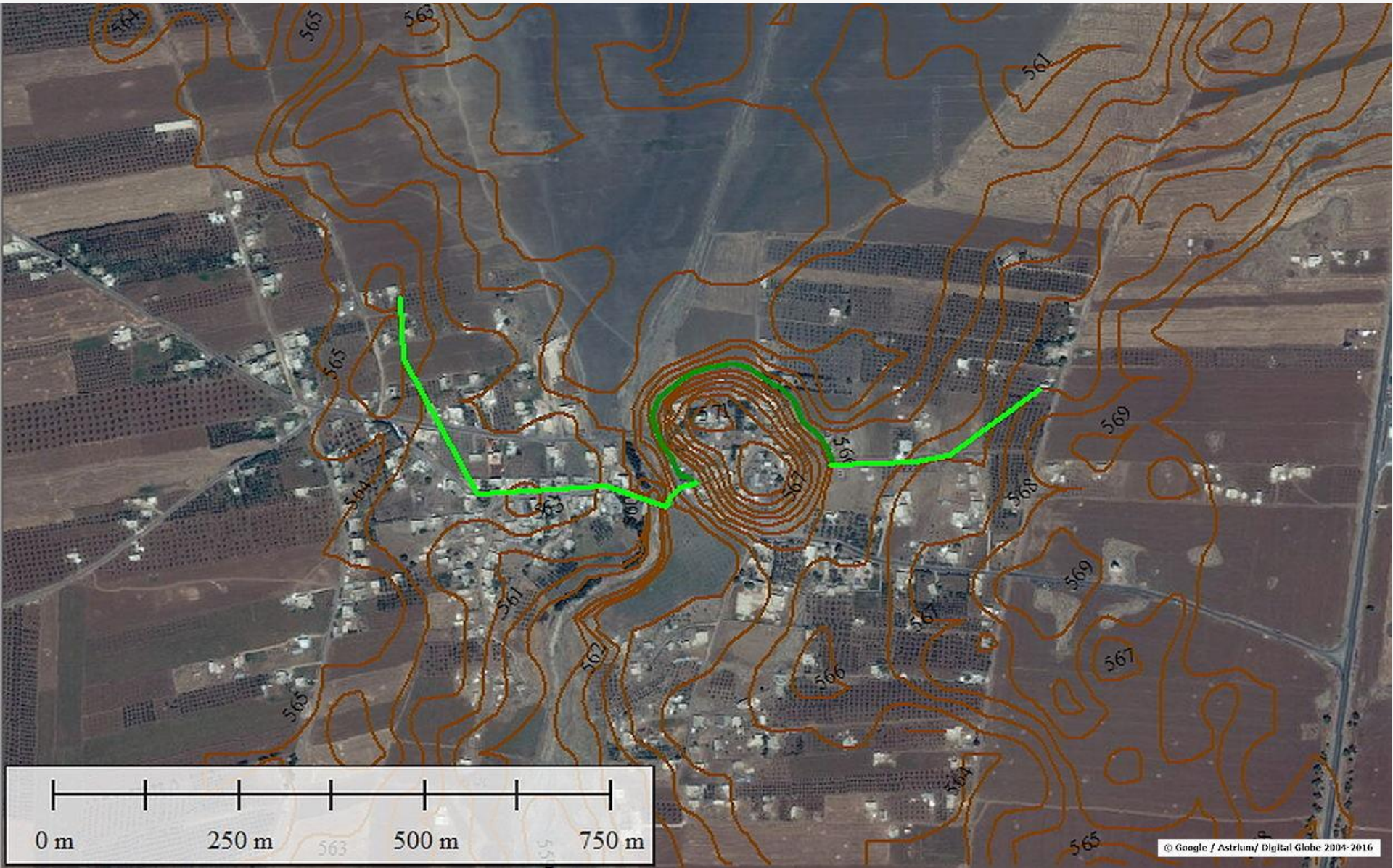
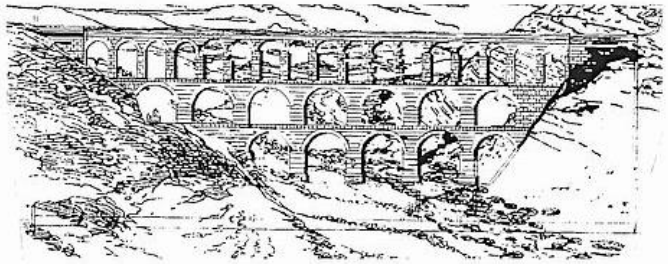


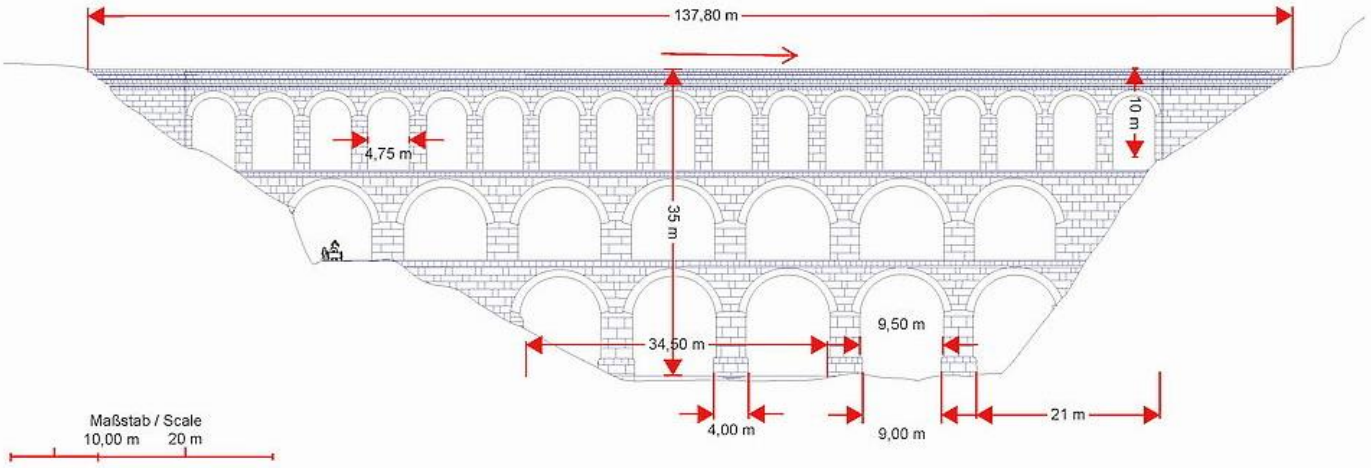
Qanat Fira’un

- Remains of a bridge over Wadi Ezraʿ, ca. 6.2 km SE from the dam
- Ca. 135 m long

Qanat Fira'un

- Reconstruction of a bridge (Jisr el-Mesari) over Wadi e-Zedi (one source of the Yarmouk) SE from Adraha
- Today partially flooded by modern reservoir

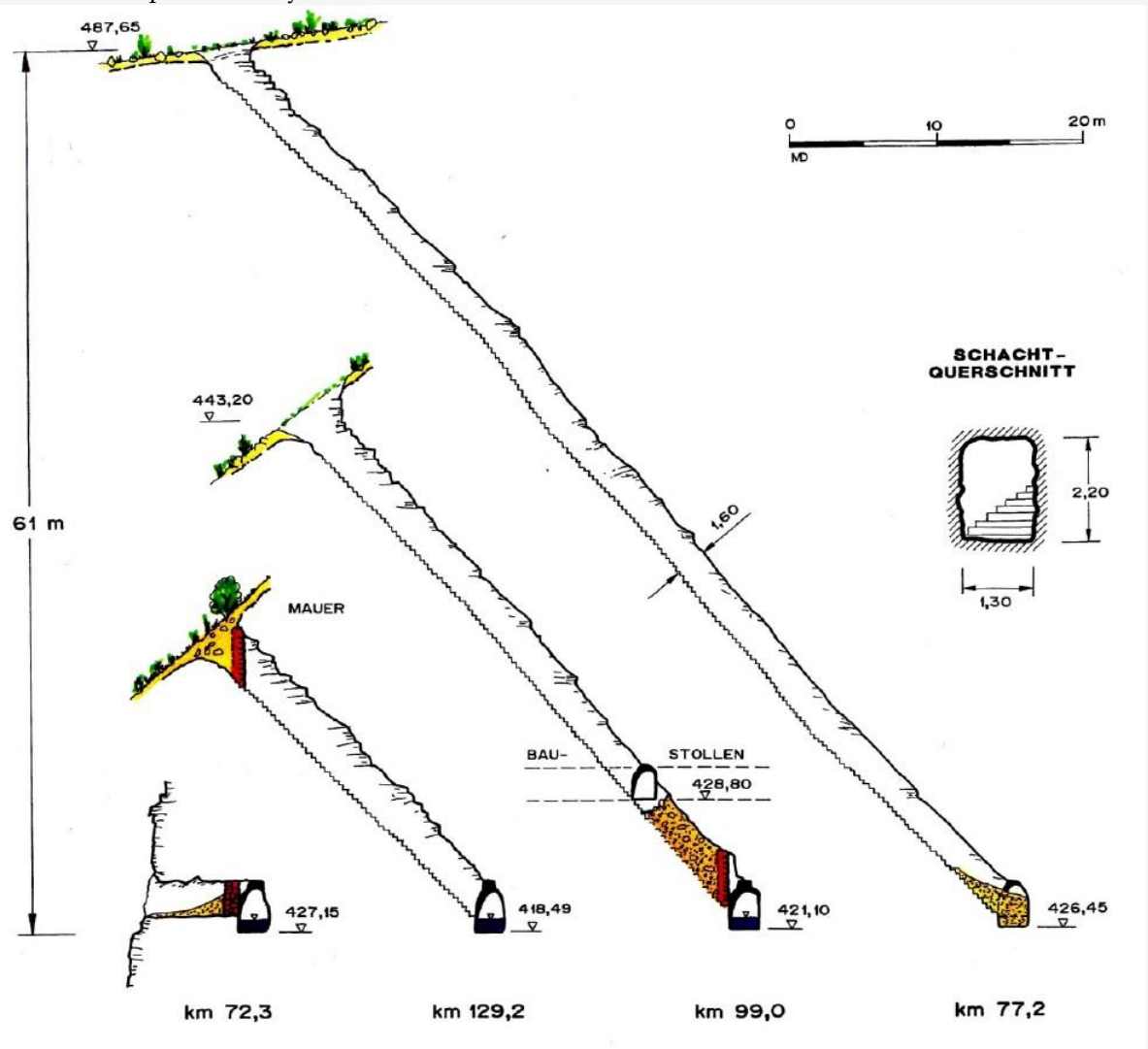


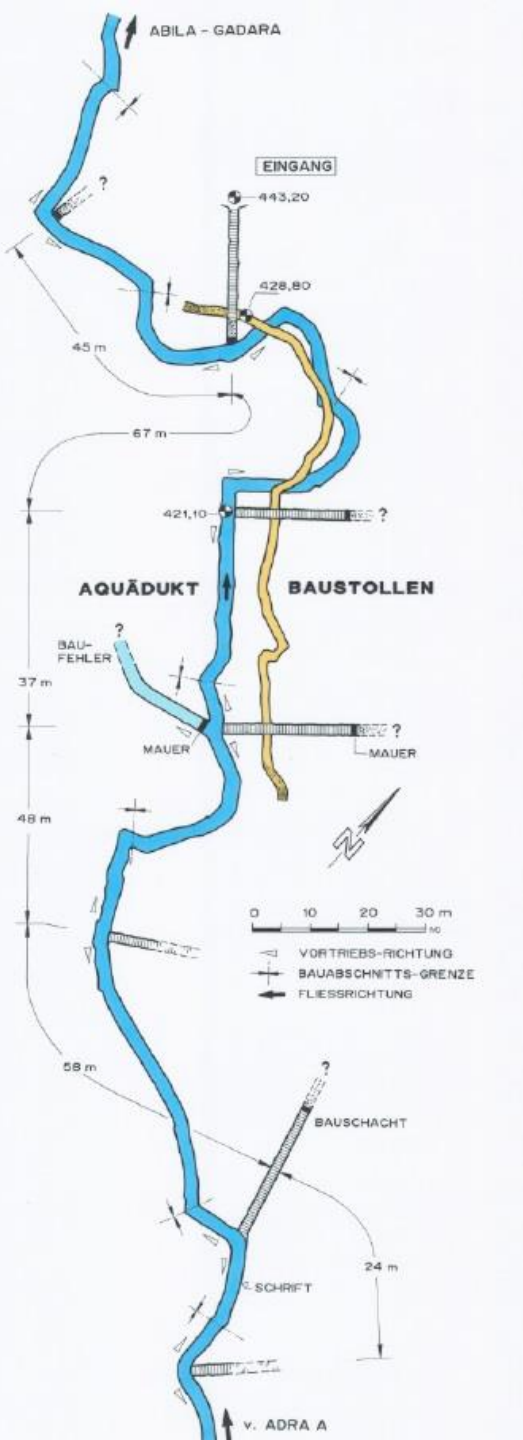


Qanat Fira'un

- After passing Dera' and Muzeirib and approaching Abila, the aqueduct is led through subterranean rock-hewn channel (mostly following contour lines), with additional springs connected to the system

Examples of access/construction shafts along the aqueduct, note lower left example carved on the slope of a valley



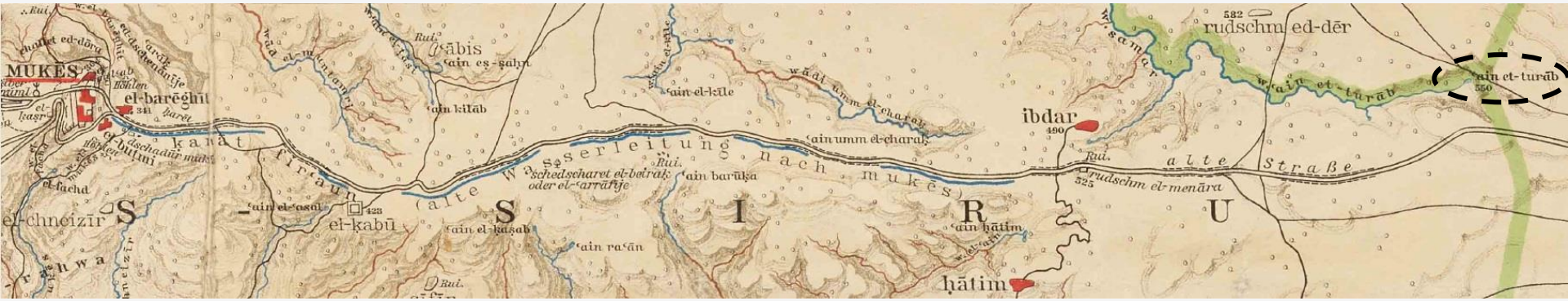


Qanat Fira'un

- The whole aqueduct system has several issues however
- It is not entirely clear if all the surveyed sections indeed belong to a single water supply system (the German mission might be overtly optimistic)
- Some differences in elevation and gradient in the section between Abila and Gadara might suggest that Gadara was not connected and that Abila was conducting water from sources to the west of the city (and not from the east through the Qanat Fira'un)

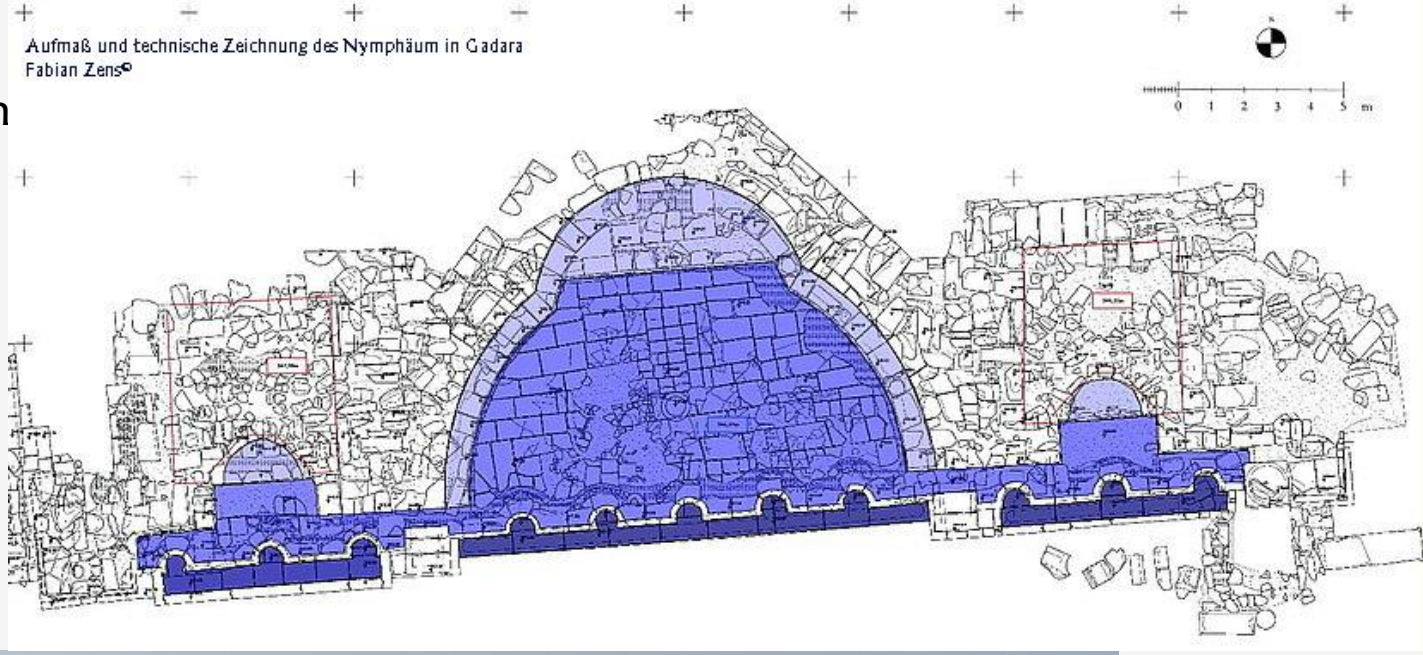
Above: view of the section of a rock-cut channel between Abila and Gadara with plastered walls

Below: map of aqueduct of Gadara (Mukes on the left) collecting water at Ain e-Turab (on the right, in black), according to G. Schumacher



Qanat Fira'un

- Nymphaeum at Gadara, putative terminus of the Qanat Firaʾun



Qanat Fira'un

- A planning of such wast system was suggested to be executed with a trigonometrical network and a *dioptra* (*dioptra* can be used as a level, distance-measuring device and angle-measuring device)
- Remains of a peculiar structure, described by Schumacher, were interpreted as one such trigonometrical point

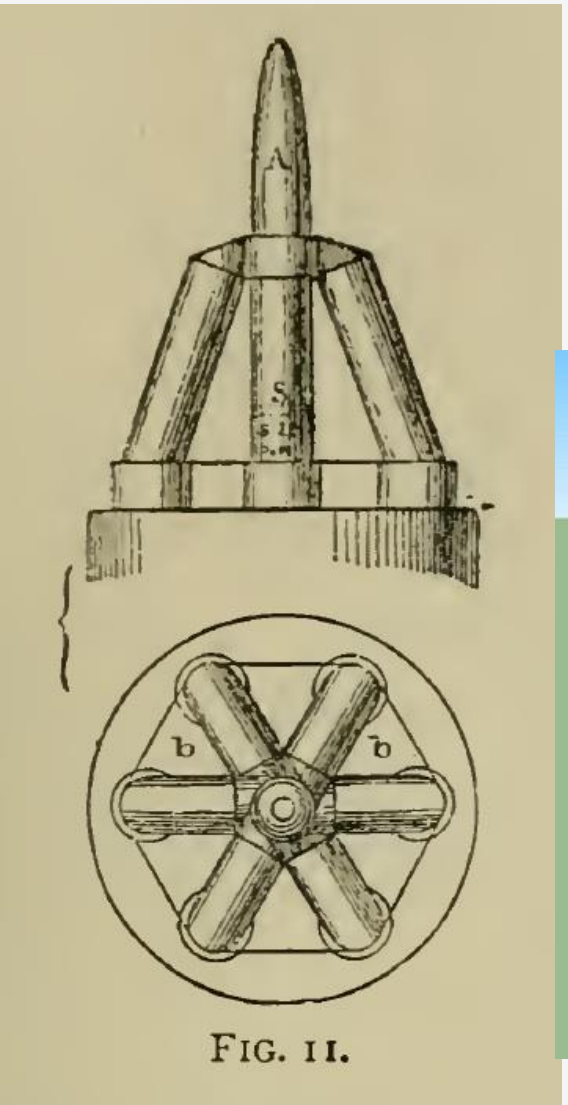
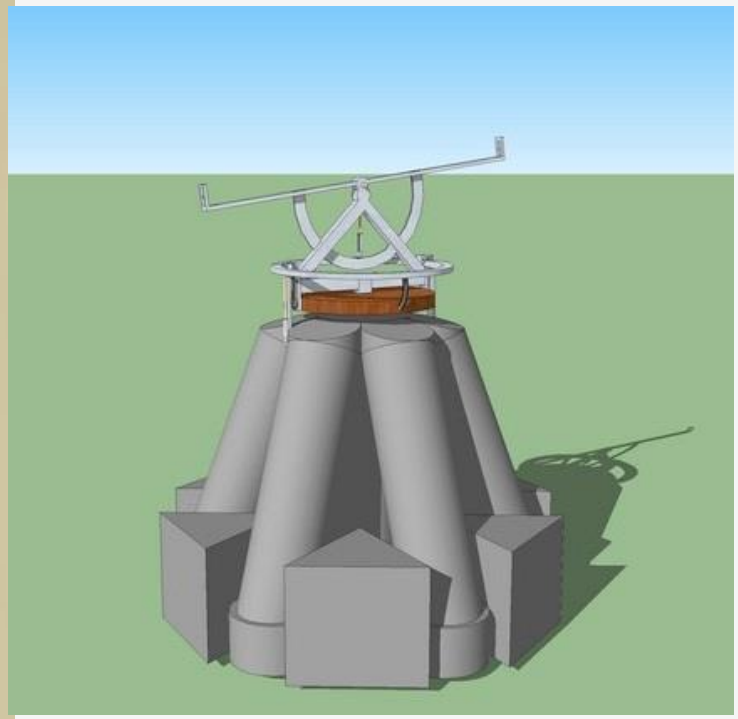
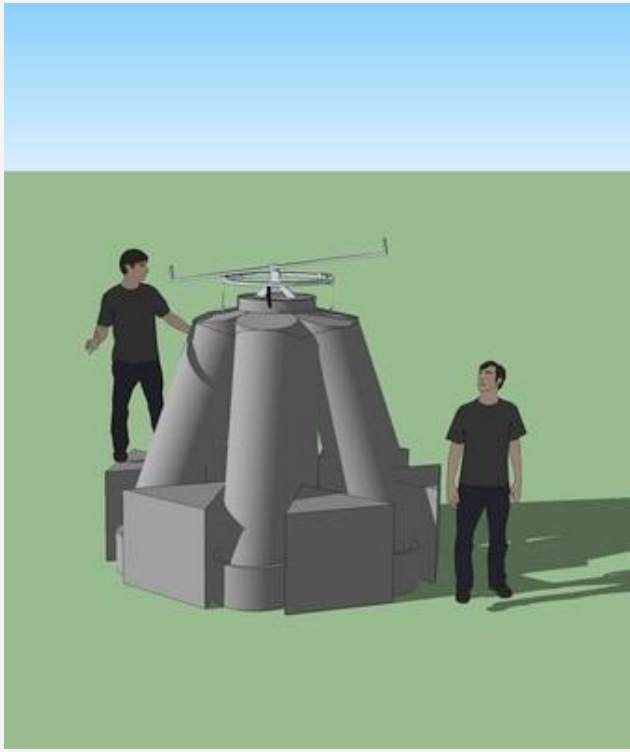


FIG. 11.

Left: Schumacher's reconstruction of a monument at 'Ain Dhakkar (no longer extant)

Lower row: modern interpretation of the structure as a base for a *dioptra* (i.e. a fixed point in a trigonometrical network of other fixed points)



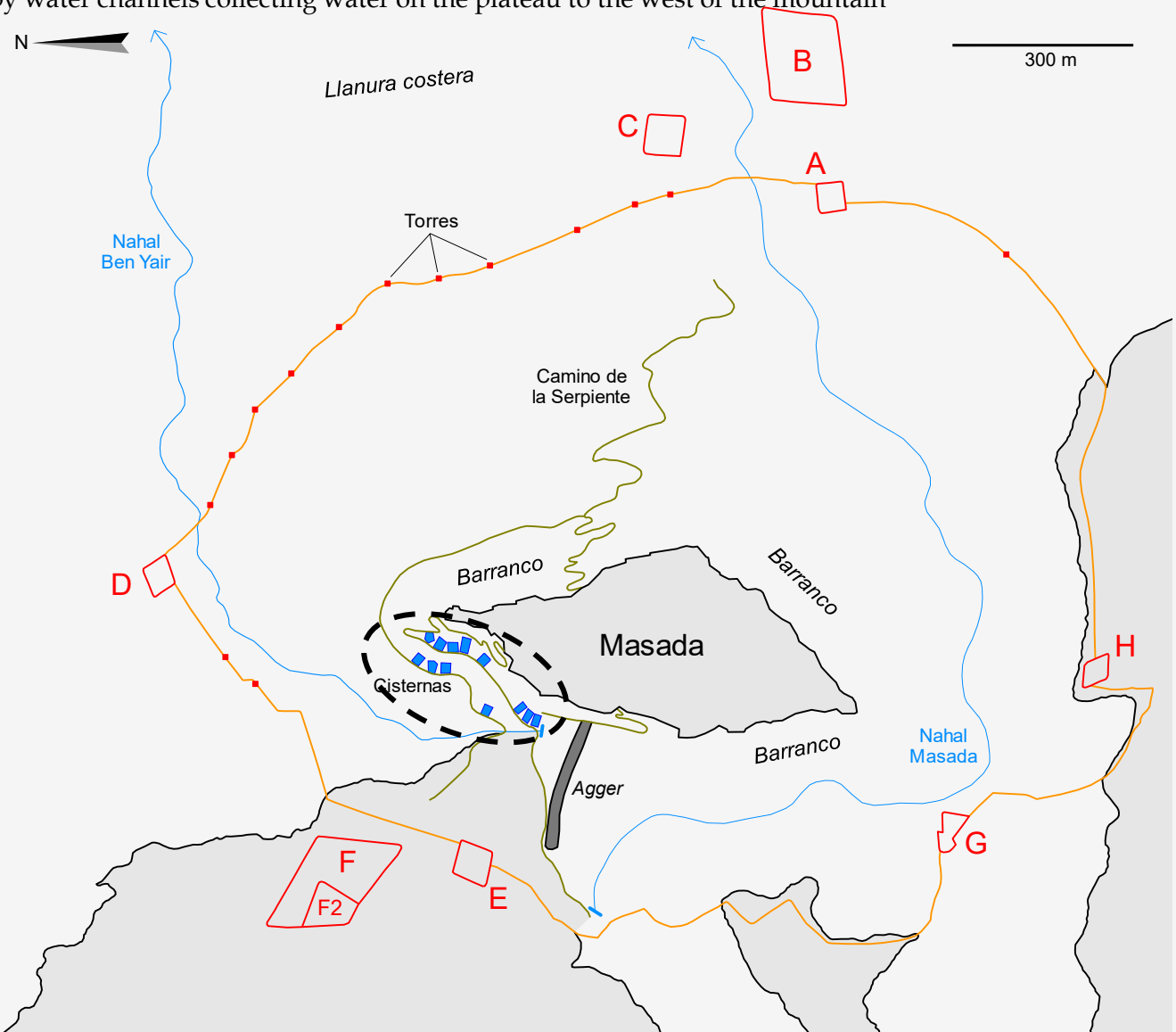


Masada

- Elaborate water supply system based on collecting run-off of seasonal rains (Masada – Dead Sea valley gets only ca. 100 mm of rain/year)
- One of the first Roman-style baths built by Herod

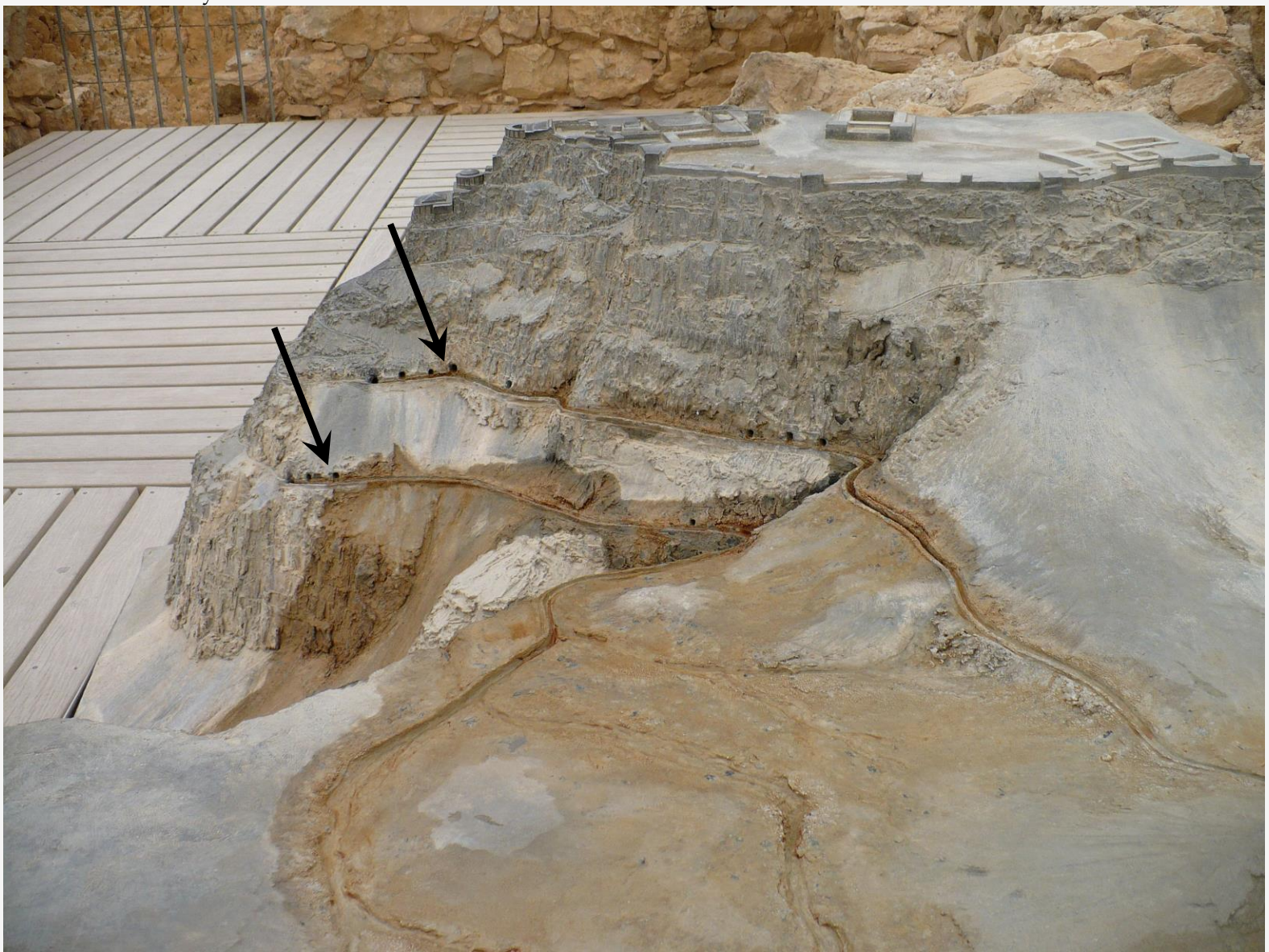
Masada

- System of large cisterns was built on the north-western slopes of the mountain
- Upper 8 with capacity of 21,500 m^3
- Lower 4 with capacity of 14,500 m^3 (comp. Hippos 1,200 m^3 for the whole city)
- They were fed by water channels collecting water on the plateau to the west of the mountain



Masada

- System of large cisterns was built on the north-western slopes of the mountain
- They were fed by water channels collecting water on the plateau to the west of the mountain
- Model of the water system



Masada

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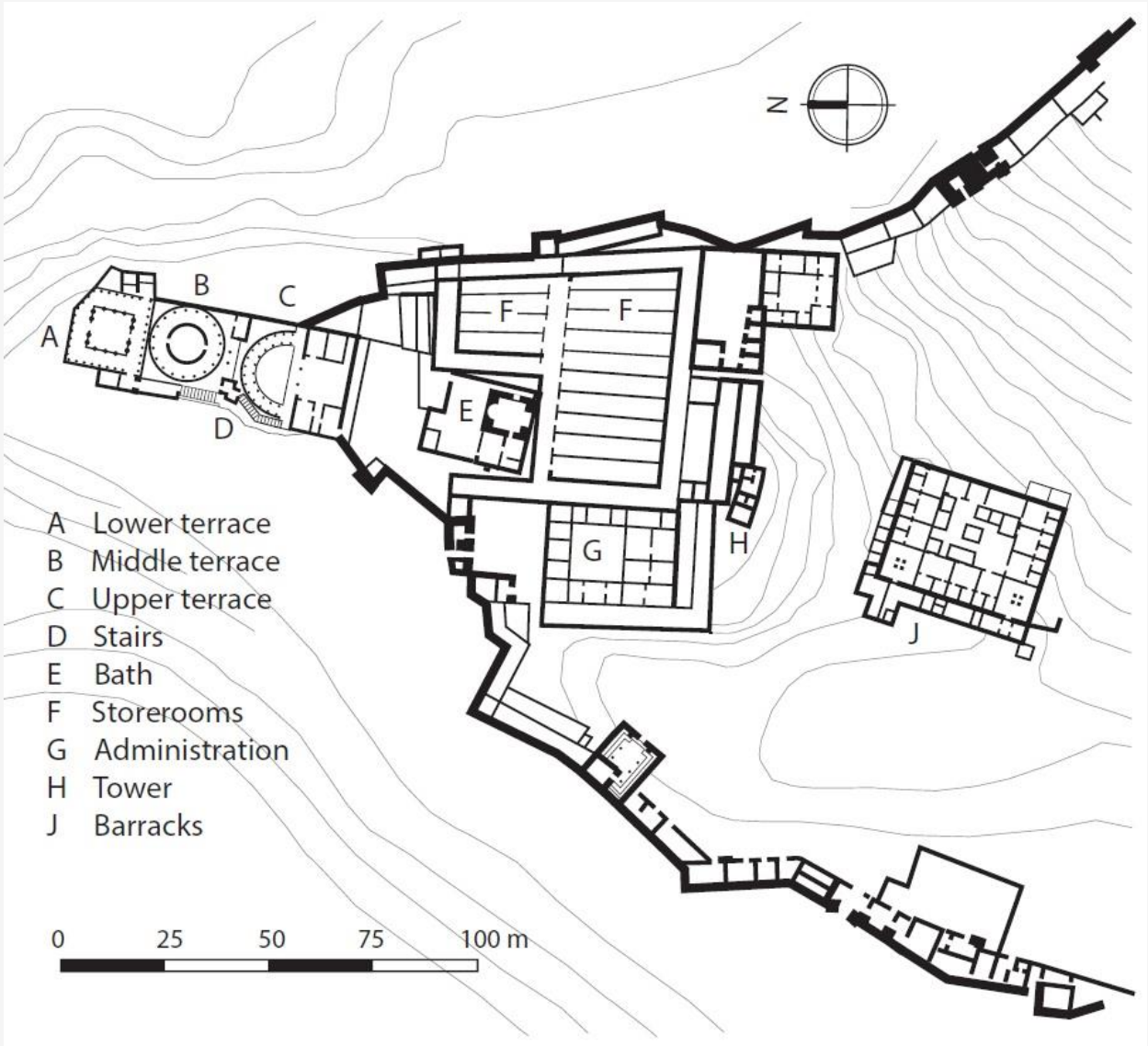
Masada

- The earlier Western palace contains a small Judaean-Hellenistic bath
- Roman-style bath were built later together with the Northern palace (E)
- Note that the bath house is built on the same axis as the palatial structures on the northern terrace

- A court (palaestra 18x8.5 m) with an exedra *distylos in antis*
- Bath house ca. 20x12 m
- The *caldarium* (hot room) was vaulted



Masada

- The courtyard (*palaestra*)
- Originally, all buildings would be covered in plaster with stucco and fresco decoration
- The floor was paved with black and white mosaic

Masada

- The courtyard (*palaestra*)
- Mosaic and remains of half-columns and walls covered in plaster

Masada

- *Frigidarium* (cold water room)
- It is built as a Jewish *mikweh* (i.e. as stepped plastered immersion pool)

- Opus sectile floor in the *tepidarium*

Masada

- *Caldarium* (hot room)
- Note the hypocaustum (heating system below the floor and on the walls)

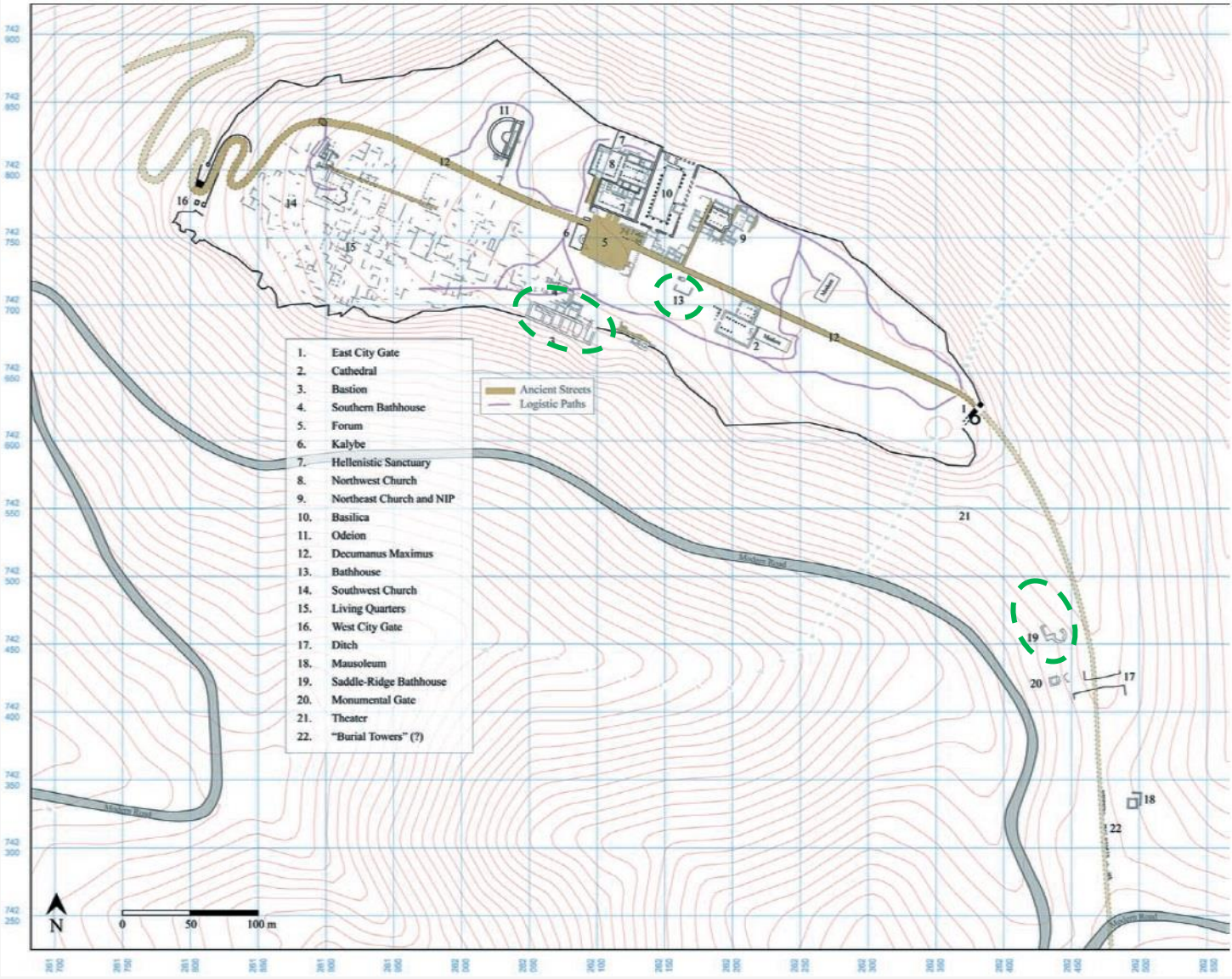
Hippos - baths

- Three known bathhouses
- Two definitely built in the Roman period
- The third might be Byzantine

- Southern bathhouse (4, along the southern wall of the city)

- Saddle ridge bathhouse (19, behind the *propylaeum* in the Roman extension of the city)

- Third bathhouse between agora and the Byzantine Cathedral (13)

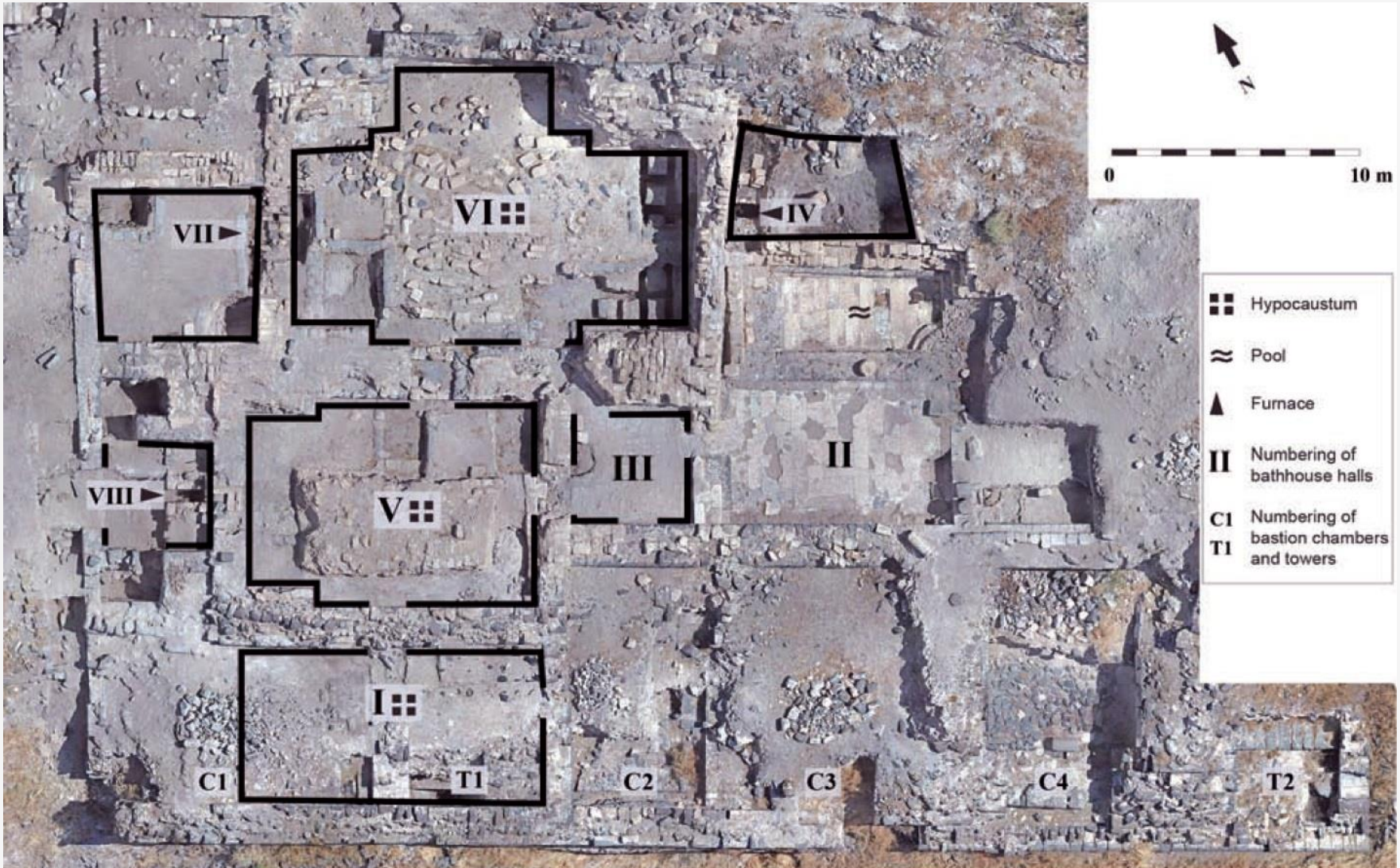


Hippos - baths

- Southern bathhouse
- So far the largest bathing complex excavated in the city (ca. 1,050 m^2)
- Built over the bastion sometime during the 2nd c. CE in the vicinity of the "civic center" of the city
- With the construction of the bathhouse the Bastion effectively went out of use, as the baths re-uses several rooms of the fortifications, rendering them useless for other uses and partially destroying upper parts of the fortifications

Hippos - baths

- Southern bathhouse
- The *caldaria* (I, V, VI) covers large area compared to *frigidarium* and "*palaestra*" (II) – additional rooms (incl. putative latrines east of room II) were probably located north on the slopes and to the east
- Note how the room I overlies bastion chamber C1 and tower T1 – both rooms were filled with cement and *hypocaustum* with new floor was laid over them



Hippos - baths

- Southern bathhouse
- *Frigidarium* and "*palaestra*"
- The pool on the right is apparently part of the *frigidarium* (note the drainage channel below the pool, still functional)
- "*Palaestra*" is rather an intermediate room (*tepidarium*?) with stone benches along the walls
- Collection of playing dice attest to more "communal" social character of the room

Hippos - baths

- Southern bathhouse
- Only the *hypocaustum* system and wall heating are built of bricks
- The rest of the structure is built of local limestone on basalt foundations
- Unlike in the Western provinces where whole bathhouses are built of bricks

Upper row: *tubuli* (left, hollowed bricks used for conducting hot air through the walls)

Bricks (right) used for *pylae* of the *hypocaustum* holding the floor

Lower row: details of the *hypocaustum* heating system

Hippos - baths

- Southern bathhouse
- The bahthouses were richly decorated on the inside

Left: Stucco relief of Heracles, apparently adorning one of the rooms
Center: A marble leg of an athlete/deity
Right: Limestone and marble slabs used for wall/floor decoration

Hippos - baths

- Southern bathhouse
- Some modifications were introduced in the mid-3rd c. CE, when *hypocaustum* in one of the rooms was dismantled
- The bathhouse went out of use at the end of the 3rd/beginning of the 4th c. CE (even before the 363 CE earthquake) and stood abandoned for some time
- Apparently at some time after the earthquake the complex was re-used and housed several domestic units, industrial areas and a garbage dump

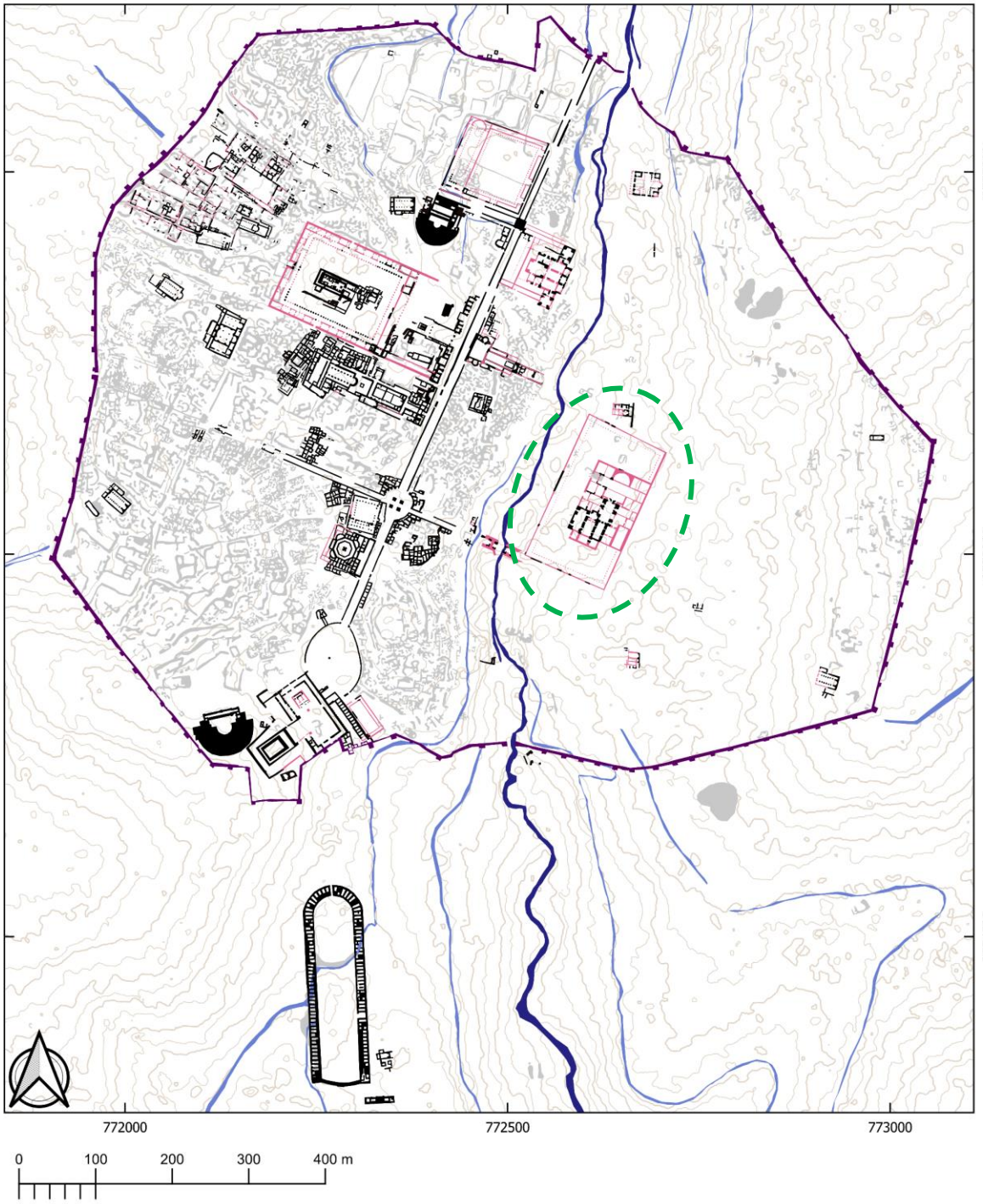
Gerasa

- The city housed at least four bathhouses in the Roman and Byzantine period
- The Eastern baths in the eastern half of the city across Chrysorrhoas river are among the largest Roman *thermae* of the Imperial type in the Eastern provinces

- They span a whole block between southern *decumanus* and *decumanus* running from the *propylaeum* of the Artemis sanctuary

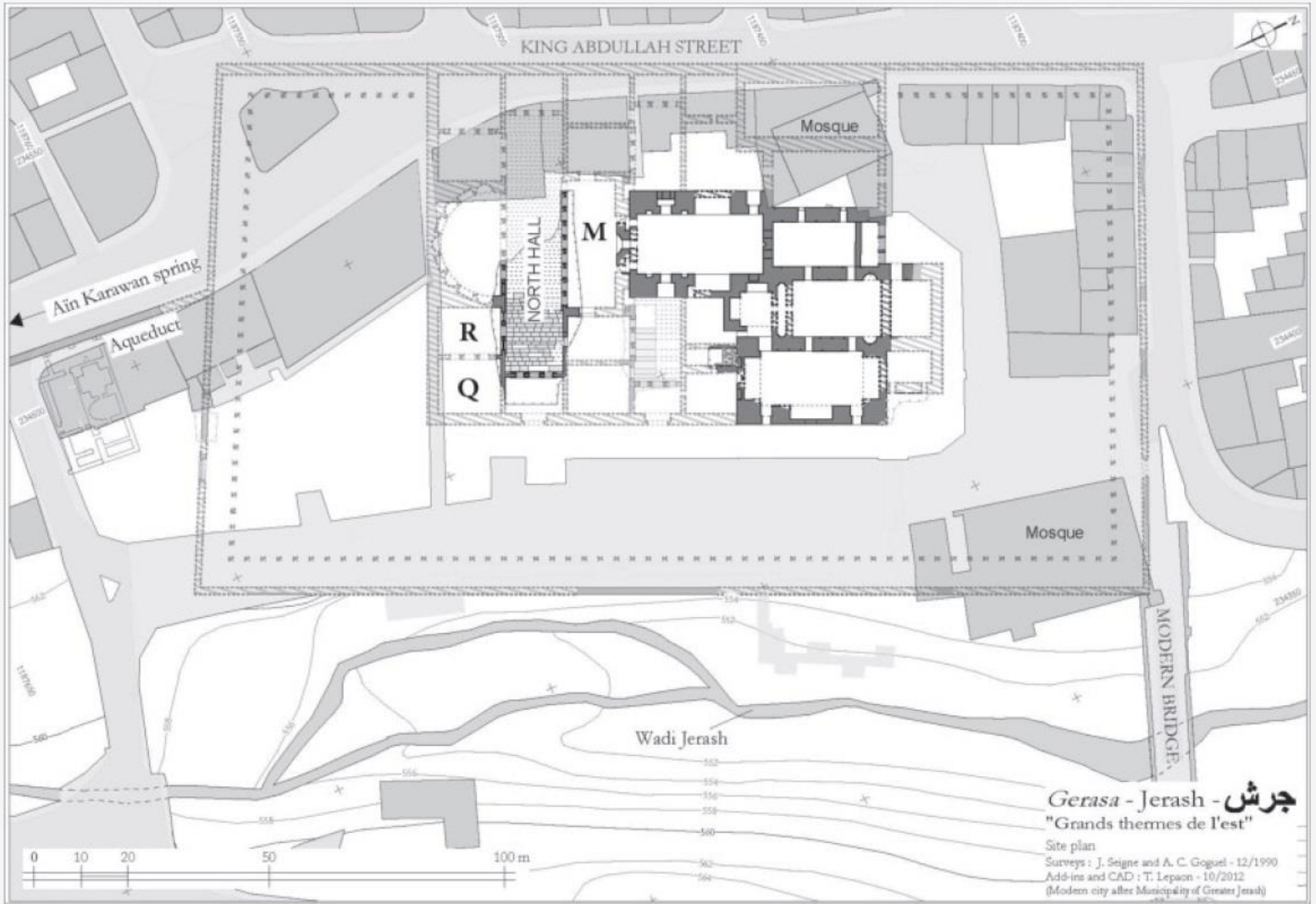
- Badly damaged by development of the modern city

- "Imperial type" – the baths are characterized by a central building with circular arrangement of rooms and large outer court with porticos and *exedrai* for exercise or study



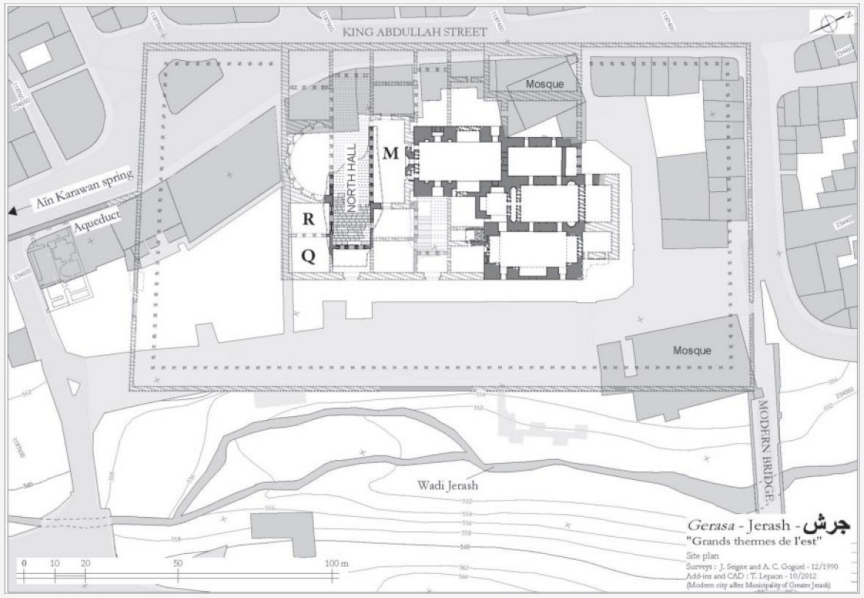
Gerasa

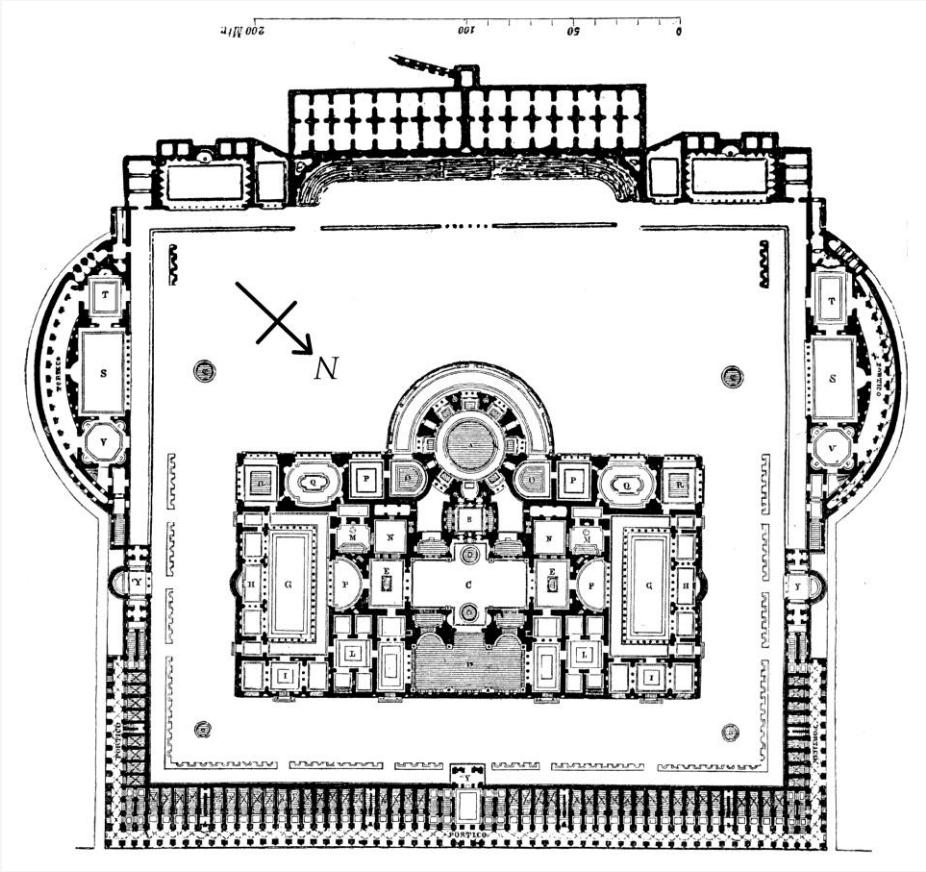
- Eastern baths
- The central building is ca. 90x100 m, while the whole complex is up to ca. 210x150 m
- Dated roughly to the 2nd/3rd c. CE, probably with final dedication in the Severan period
- Some activity continues until the Byzantine period, partially abandoned or re-used from the 5th/6th c. CE onwards



Gerasa

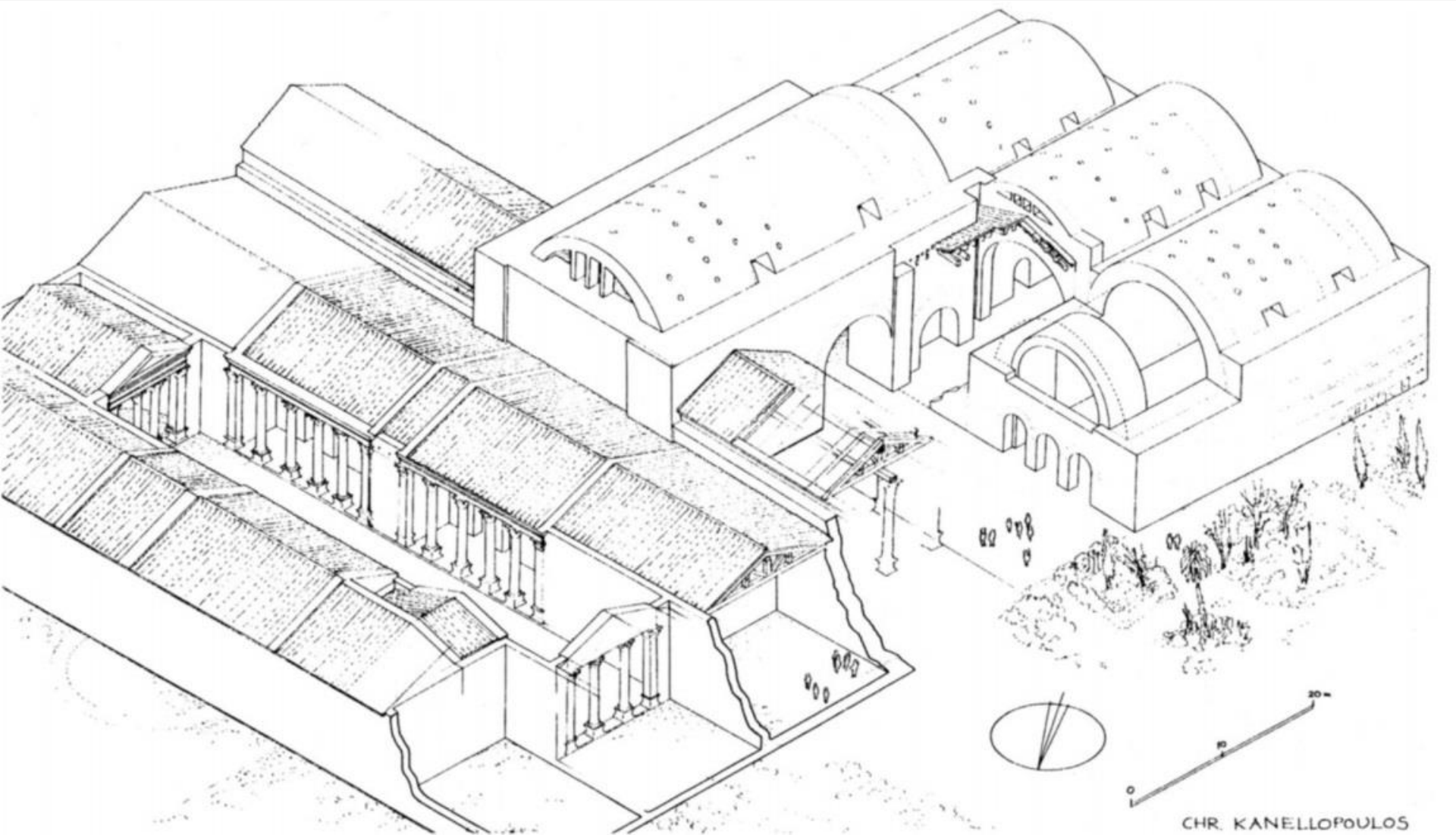
- Eastern baths
- Comp. to Baths of Caracalla in Rome (approx. contemporary) to scale
- Baths of Caracalla: outer dimensions 412x393 m; central building: 214x210 m





Gerasa

- Eastern baths
- Partial reconstruction of the central building
- The vaulted halls on the right are baths buildings, the Northern Hall on the left probably represents area for gatherings and activites relating to social and cultural function of the bathhouses (learning, lectures etc.)

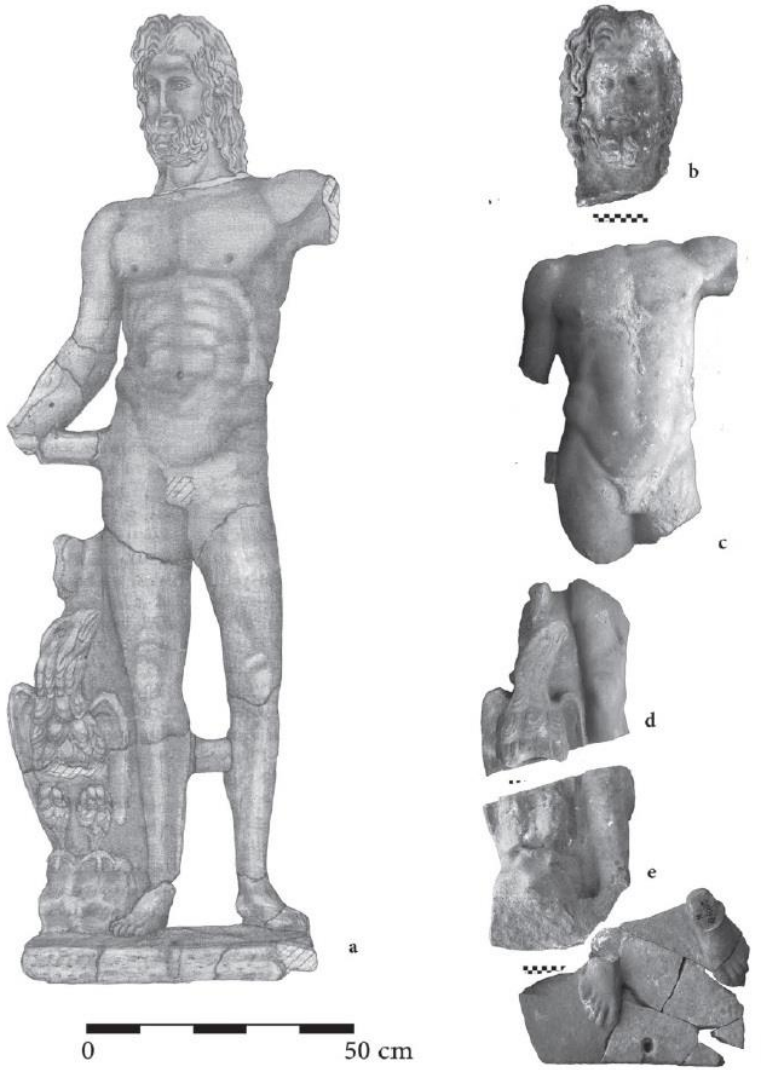


Gerasa

- Eastern baths
- Like other bathhouses in the Roman period, they were also richly decorated
- Mostly Roman copies in marble of Greek Classical/Hellenistic types

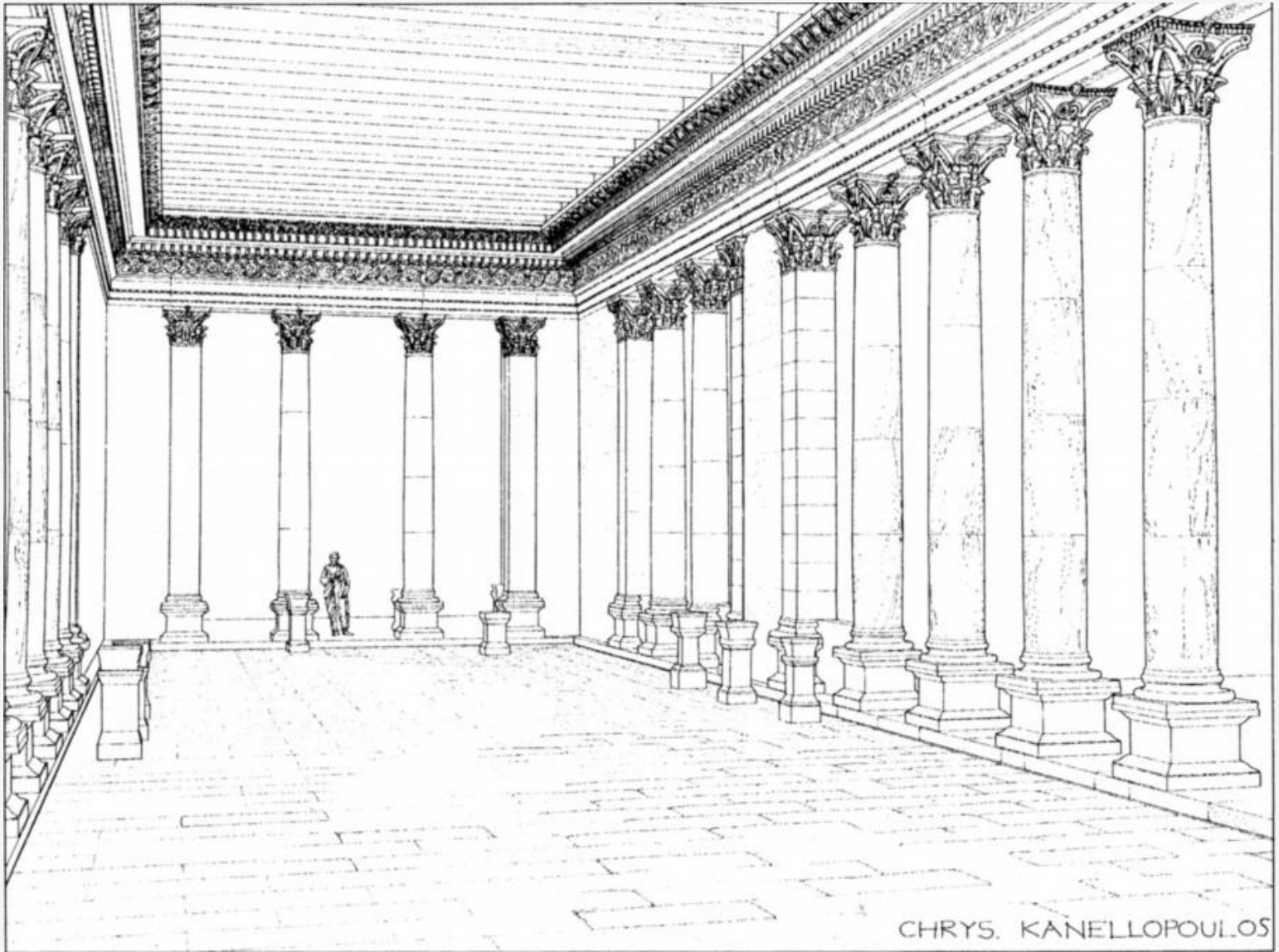
Aphrodite of Demetrius (h. = 2.08 m)

Zeus type Florence (h. = 1.74 m)



Gerasa

- Eastern baths
- The basilical North Hall provided ample evidence for dedications of sculptures for the decoration by the citizens of Gerasa
- The sculptures represent both deities and local patrons (represented as Roman citizens, clothed in *toga*)



Gerasa

- Eastern baths
- All sculptures are carved from marble imported from Greece and Asia Minor

Togatus with a scroll (i.e. citizen type not an Imperial official, probably a local patron), h. = 1.3 m

Asclepius, h. = 1.1 m

Excursus – Gymnasia and baths

- *Gymnasion* is prime Greek institution, where young men (future citizens of a *polis*) received their education
- The education consisted of *gymnastike* – physical exercise (probably including military training;), *musike* (music, poetry, dancing) and rhetoric, philosophy and other liberal arts
- Young men were thus getting accustomed to the Greek cultural norms, traditions and patriotism

- No specific *gymnasium* building is known in the Near East
- Herod is said (BJ 1.422) to build *gymnasia* in Damascus, Tripolis and Ptolemaïs, but none of these was ever identified
- Numerous inscriptions of the Hellenistic and Roman era however attest the existence of the *gymnasium* as an institution
- Epigraphically attested is in Gerasa, Gadara, Philadelphia and Palmyra (and further in Antioch on the Orontes and Seleucia)

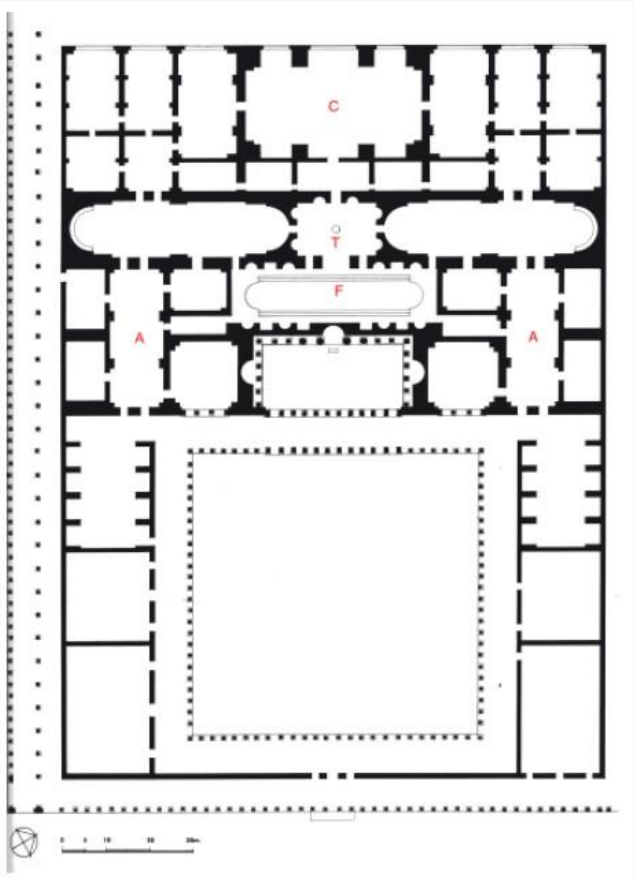
- Baths buildings are known to hold gymnasia in the Asia Minor and it is possible that some baths in the Levant were used in the same way (Gerasa perhaps)

…Ἀριστονᾶς Ἀριστο[μά]χου

γυμνᾰσιαρχήᾰ[α]ς…
Inscription of Aristonos, son of Aristomachos, *gymnasiarches* (the man in charge of a *gymnasium*)
Gerasa, ca. 42 CE (I.Gerasa 3)

"…The square or oblong **peristyle in a palaestra** should be so formed that the circuit of it makes a walk of two stadia…Let three of its colonnades be single, but let the fourth, which is on the south side, be double, so that when there is bad weather accompanied by wind, the drops of rain may not be able to reach the interior…In the three colonnades construct roomy exedrai with seats in them, **where philosophers, rhetoricians, and others who delight in learning may sit and converse**. In the double colonnade let the rooms be arranged thus: the young men's hall in the middle…the **cold washing room** …At the left of the young men's hall is the **anointing room**; then, next to the anointing room, **the cold bath room**, and beyond that a passage into the furnace room at the corner of the colonnade. Next, but inside and on a line with the cold bath room, put the vaulted **sweating bath**…" Vitruvius (5.11.1-2) on Greek *gymnasion*

So-called Bath-gymnasium in Sardis, Asia Minor, 2nd c. CE



Hammat Gader

- Hot springs and sub-urban settlement north of Gadara on the Yarmouk river (see previous lecture and *naumachia*)
- Ca. 160 m **below** sea level, a maeander (ca. 60 ha) in the deep ravine of the Yarmouk river (surrounding hills are 300+ m **above** sea level)

Hammat Gader

- Particular geological setting (between the Golan basalt plateau to the north, limestone massif of the north-eastern Jordan and along the Jordan Rift) caused emergence of five abundant springs in the area
- Three (ʿAin el-Maqle, ʿAin e-Rih, ʿAin el-Jarab) are hot springs (37-51° C)
- Two (ʿAin Bulus and ʿAin e-Sahne) are cool and potable
- Medicinal spa complex of the Roman period was built around ʿAin el-Maqle (51°C; no. 1 on the map)

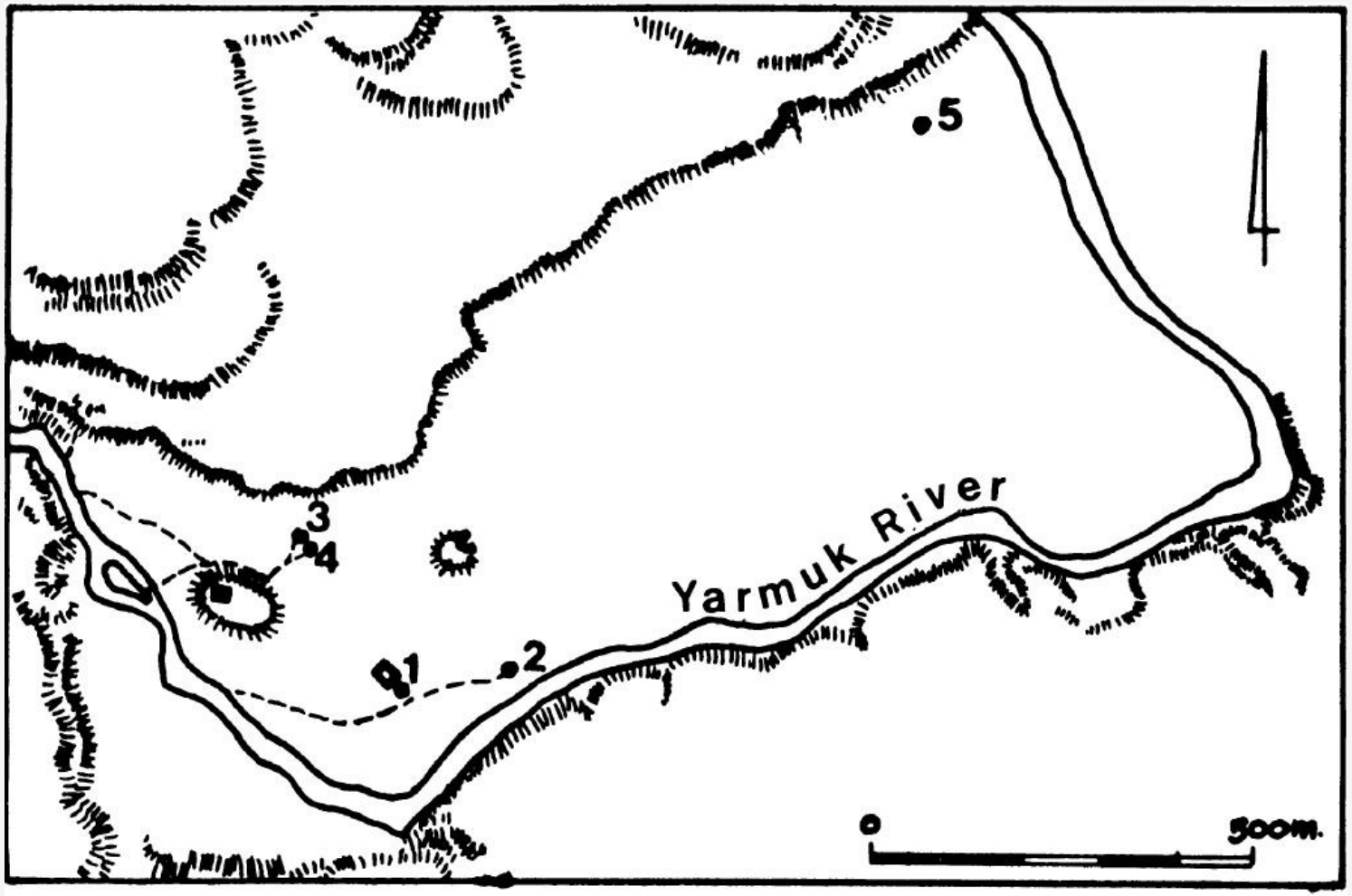


Fig. 1 Map of the site showing the locations of the springs. 1. *ʿAin el-Maqle*, 2. *ʿAin er-Rīḥ*, 3. *ʿAin eğ-Ğarab*, 4. *ʿAin Būlus*, 5. *ʿAin es-Sāḫne*

Hammat Gader

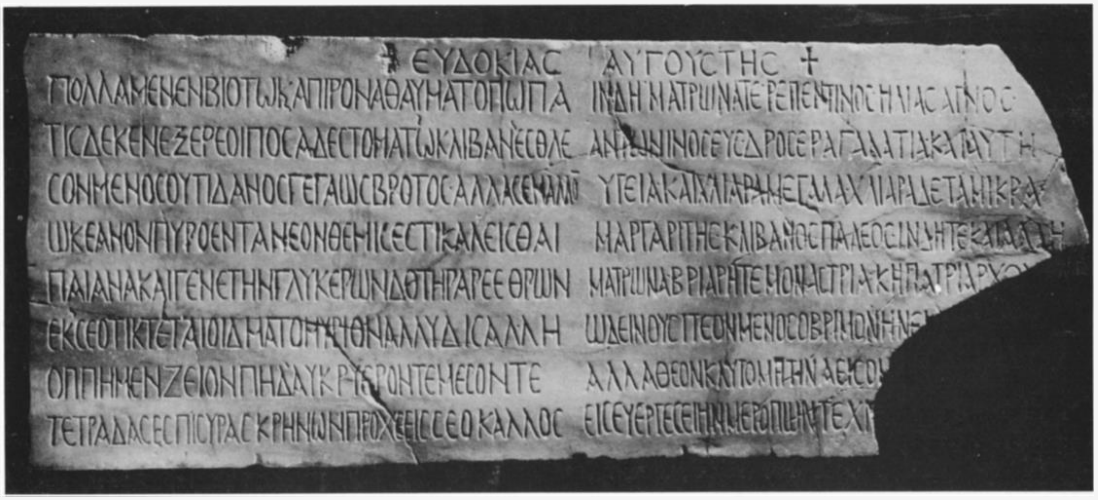
- The spa is mentioned (unequivocally) for the first time in the 3rd and 4th c. CE

"Gadara…where there are famous *thermae*…" (Origen, Comm. John 6.24)

"And there is another village, Emmatha, near Gadara, where there are *thermae*." (Eusebius, Onom. 22.26)

- The healing spa were used until the Umayyad period. People continued to come to the place (which already lacked any bath buildings by then) at least until 12th/13th c. CE according to the Arab Medieval geographers
- In modern times the springs were again re-developer as a spa and hotel complex (and a crocodile farm)

- In the Byzantine and Umayyad period the spas benefitted from Imperial benefactions as evidenced by several building inscriptions concerned with restorations and additions (might be also the case in the Roman period)
- Many dedicatory and votive inscriptions were uncovered inside the spa complex – medicinal water springs were also places of a cult (of healing deities sich as Asclepius, Hygieia etc. Yet firm evidence for such cult in Hammat Gader is missing), therefore people often dedicated votives to the sanctuary upon their recovery from illness
- In the Byzantine period the place was renowned for healing leprosy

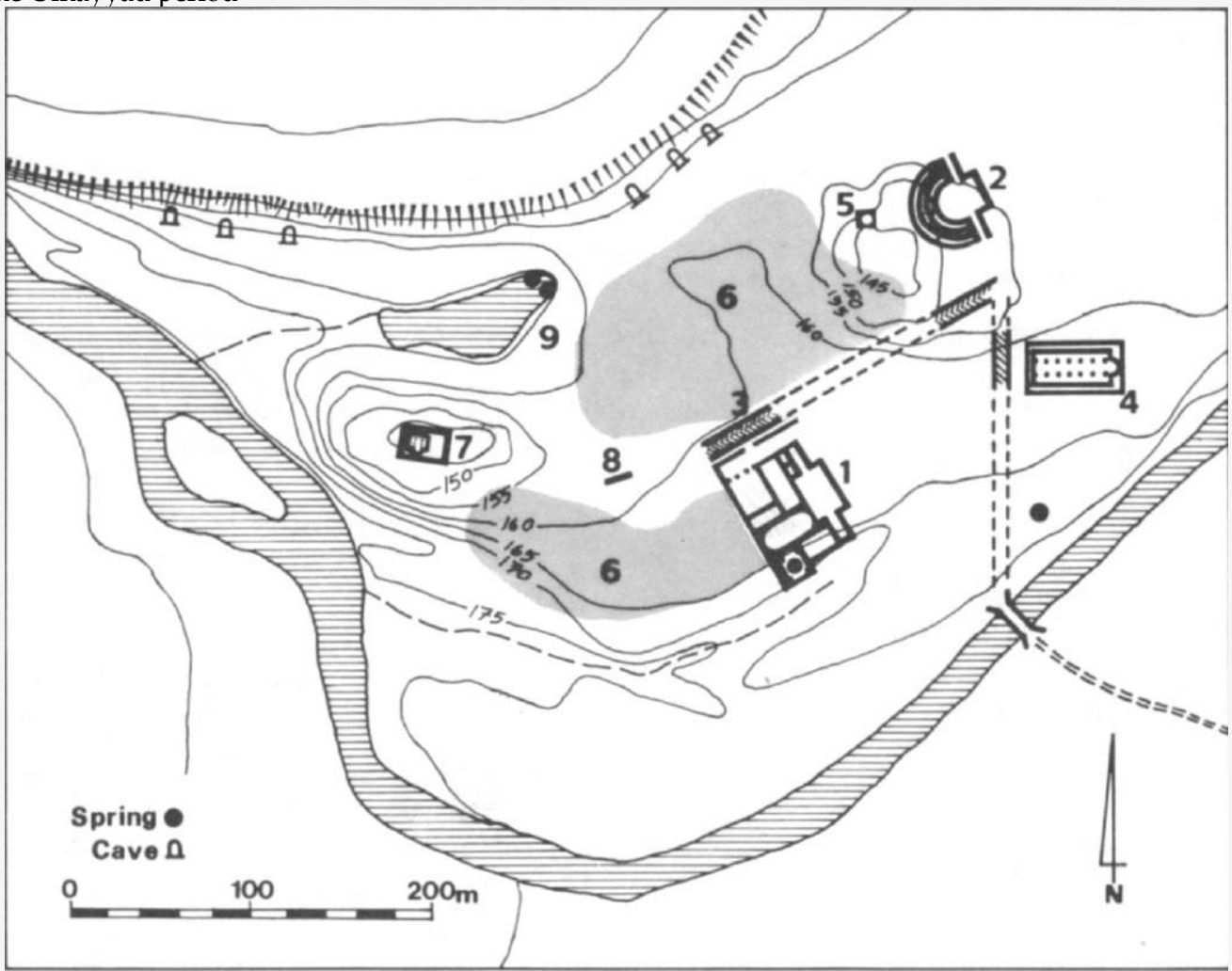


A rhymed inscription commissioned on behalf of Empress Eudocia (5th c. CE)

A Greek inscription of caliph Muawiya, restoring the baths (663 CE)

Hammat Gader

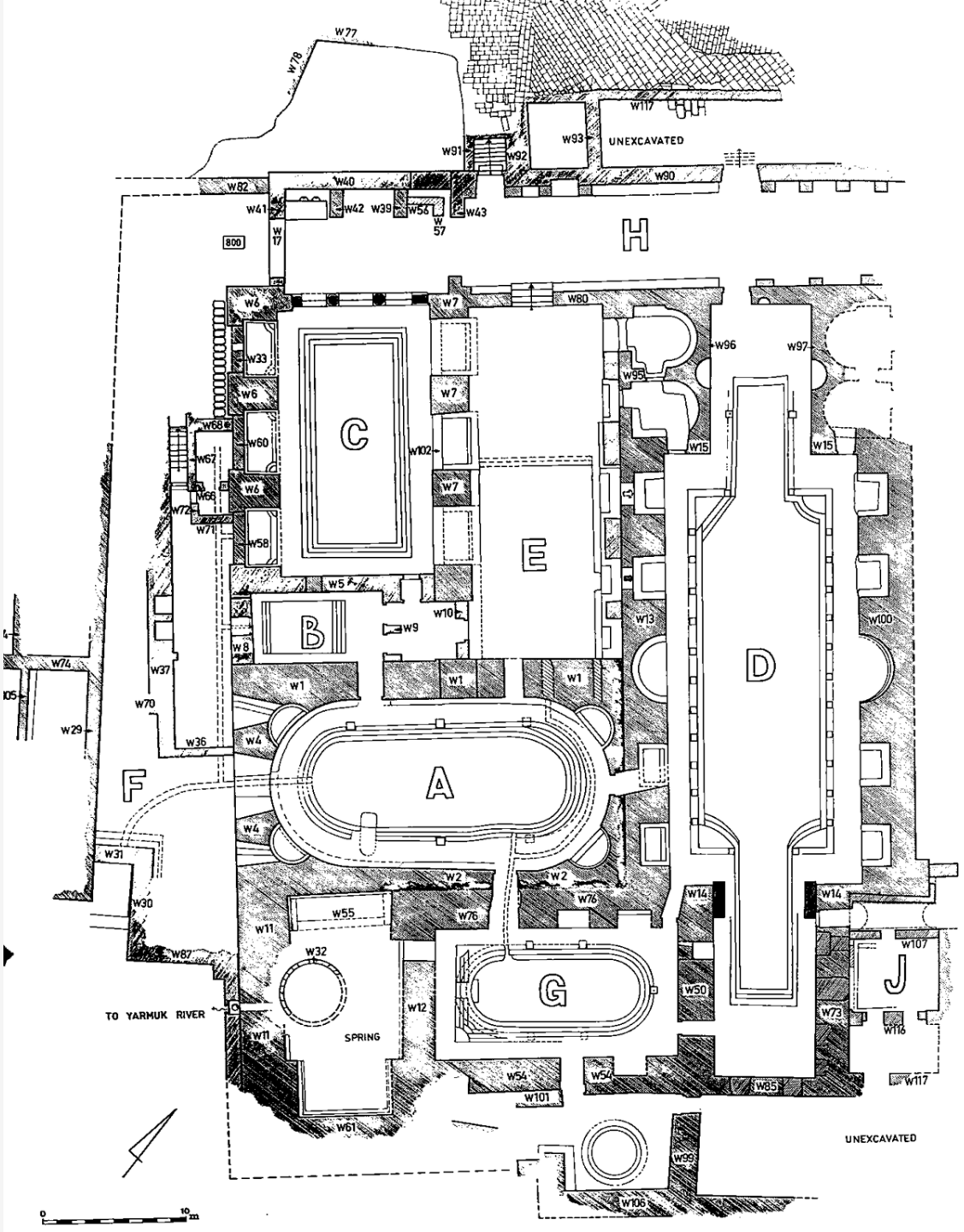
- The spa complex (1) underwent several phases of development from its erection in the 2nd c. CE to the destruction by earthquake in 749 CE
- Built probably in the time of Antoninus Pius (ca. 142-161 CE), as one part of the complex was named after him)
- Two additional building phases in the Byzantine period (mid-4th – mid-7th c. CE)
- Repairs in the Umayyad period



Hammat Gader

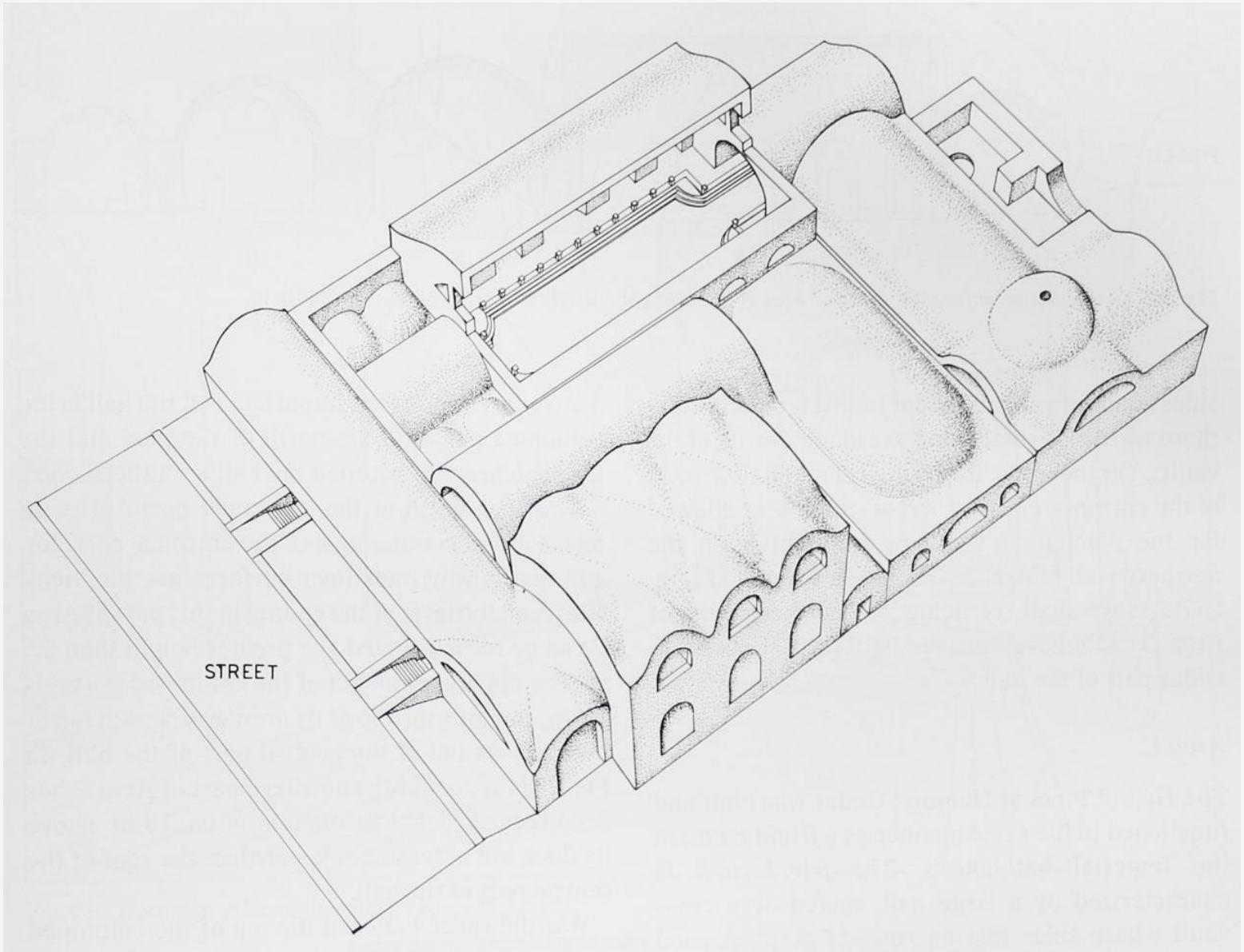
- The spa building covers ca. 5,500 m^2
- H – a paved corridor opening to the colonnaded street (above)
- A peristyle courtyard is usually reconstructed built on the north-east of the bath building (next to the hall D)
- E – entrance hall ("Hall of Inscriptions")
- C – *frigidarium*
- B – *tepidarium* (? with a pool)
- A – *caldarium* ("Oval Hall")
- G – "Hot Spring Hall"
- D – "Hall of Fountains"

- Actual spring is in the circular structure to the west of room G
- Spring and rooms A and G are connected with a discharge of water into the river (F)
- Rooms B, C and D are fed by cold water springs
- All rooms were originally vaulted with barel vaults with exception of room C which was covered by a cross vault



Hammat Gader

- Isometric reconstruction of the spa complex, note the vaulting of the individual rooms and a dome above the hot spring



Hammat Gader

- Like other bathhouses in the Roman period, the baths in Hammat Gader were richly decorated, however the remains of decoration (marble cladding of walls, sculptures…) are more scanty due to the many restorations and consequent robbing of the material

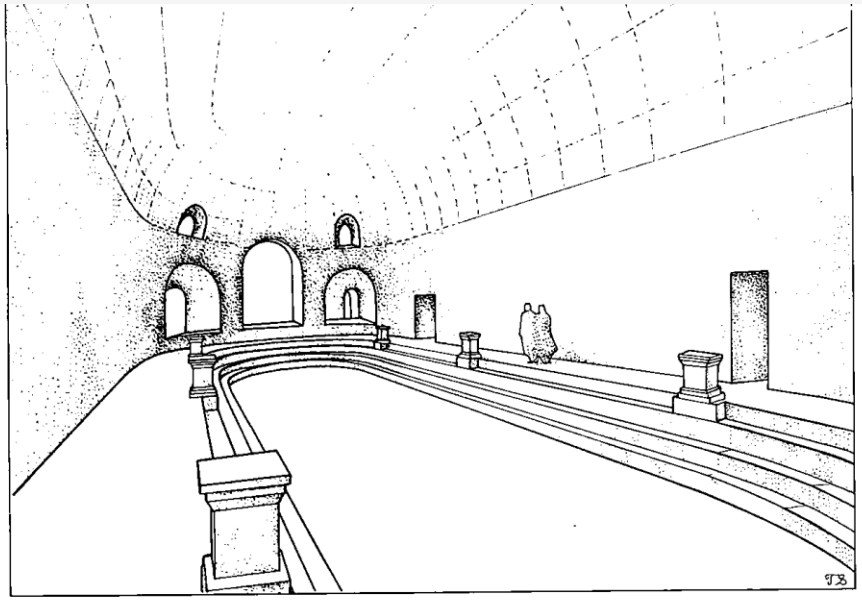


Fig. 261. Reconstruction of the interior space of Area A.

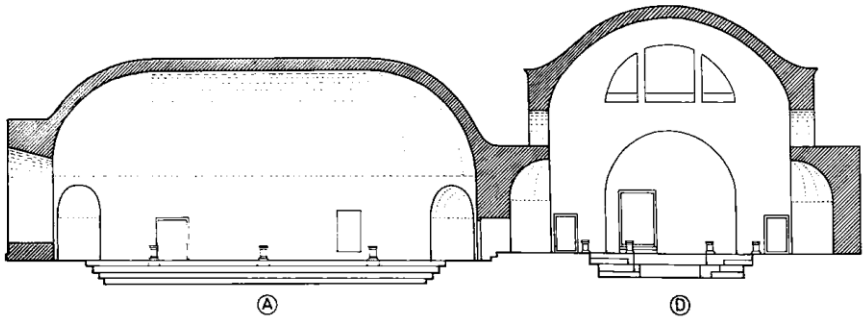


Fig. 262. Cross section along the length of Area A and across the width of the central part of Area D.

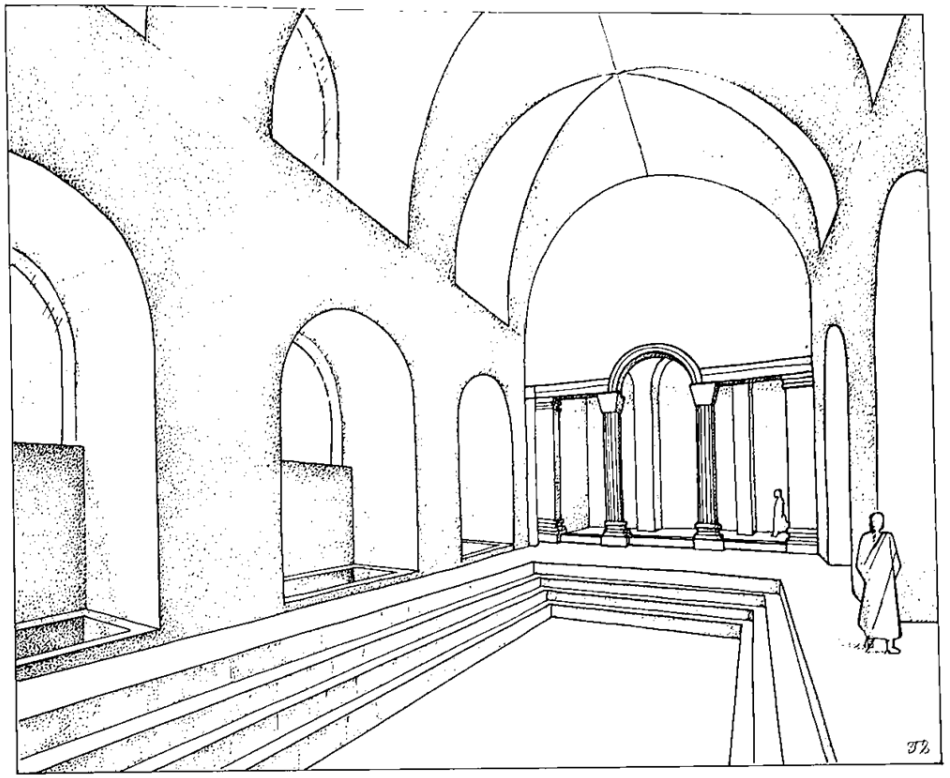


Fig. 256. Reconstruction of the interior space of Area C.

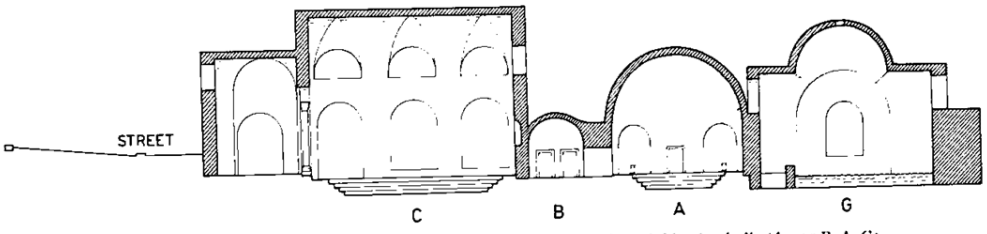


Fig. 257. Cross section along the length of Area C and across the width of the neighboring halls (Areas B, A, G).

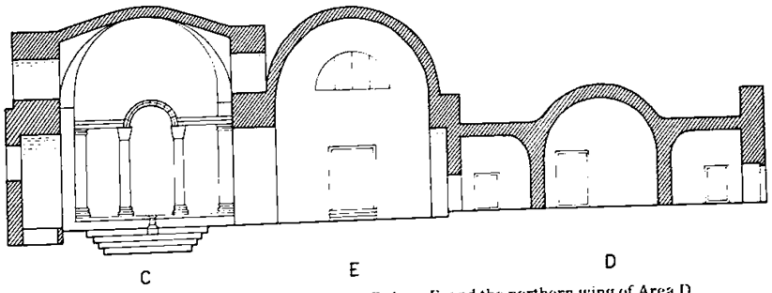
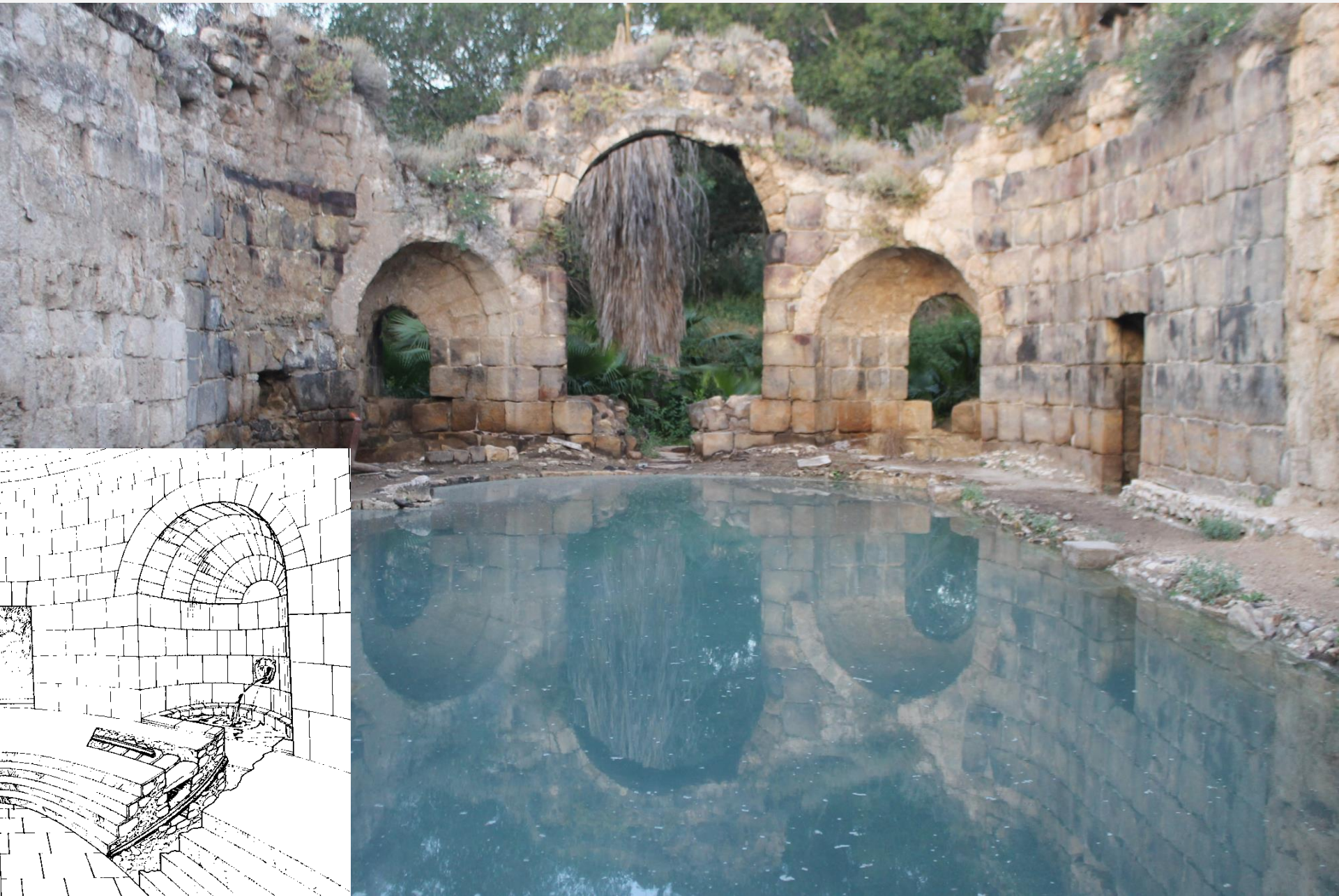


Fig. 258. Cross section across the width of Area C, Area E, and the northern wing of Area D.

Hammat Gader

Room A



Hammat Gader

- The 28 pedestals around the pool are in fact marble fountains bringing water to it
- The niches alng the wall were additional fountains with small pools (/bathtubs?)

Room D

Brief summary

- Rainfall variations during the year necessitate long-term planning of the water supply
- Exploitation of natural springs and rain run-off during winter months by building water channels, dams and cisterns in the region goes back at least to the Bronze Age – and these technologies are still used in the Hellenistic and Roman period
- Hellenistic and Roman engineering brings some innovations (hydraulic plaster, arched bridges, inverted siphons, settling basins etc.)
- Especially Roman surveying methods brought qualitatively new level to the planning of water supply, enabling to plan and build vast projects (Qanat Fira'un)
- Such projects probably spanned decades and the expenditure must have necessitated intervention of the provincial or even Imperial government (although direct evidence in the case of southern Levant is lacking) – possible only in the period of *Pax Romana*

- Some bathing culture exists in the region before the Hellenistic and Roman periods (e.g. Jewish ritual bathing etc.)
- In the Hasmonaean period a "hybridization" of Greek and Jewish bathing facilities starts to take place, which continued further under Herod
- Herod (again) introduces Roman-style *thermae* to the Near East
- Large public baths in the cities are being erected (in the Roman fashion) during the 2nd-3rd c. CE – they are among principal foci of city's social and cultural life, places not only for bathing and exercise but also for learning
- Some of them are apparently influenced by large Imperial *thermae* in Rome (Gerasa)
- Unlike in previous periods, baths are now build also in places of natural (hot) springs with assumed medicinal properties (Hammat Gader; also En Tzur, Birketein etc.)
- The abandonment of public baths (with exceptions of the medicinal spas) during the Byzantine period (but in Hippos and elsewhere apparently even earlier) has to do with cities being unable to cover the expenses of their maintenance and changing attitude of the Church to public bathing