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Planning Water Quality: Potable and Subpotable Water at Selinus and Priene

Nothing can make water better.

—Ursula Le Guin
Always Coming Home

PRINCIPLES

Today when the rigors of an arid climate (Arabia) or other constraints on water resources press the limits of water supply, hydraulic engineers have to reconsider the nineteenth century answer of one quality of water for all uses. In places where population density far exceeds the supply of potable water—Hong Kong—or where the scanty spring water is not enough to support the massive tourist industry—Bermuda—(Deb, 1987, 222) there is no choice but to use subpotable or nonpotable water whenever feasible. Absolute scarcity of drinking-quality water is the strongest reason for water managers today to consider alternate procedures, but in some situations the quality not quantity of water is the issue. Heavy metals, long-lasting pesticides, or other carcinogens may require separation of the purest supply for drinking and cooking from the less pure supply for other uses, lest the water itself cause disease during a lifetime of use. Since potable water amounts to a small fraction of use in a modern city—6 percent or less (J. Thapa, personal communication)—alternative delivery systems for that small amount may be feasible, with the main systems delivering subpotable water for bathing, cleaning, watering lawns, and so on, and nonpotable water for industry or irrigation.

It is easier to contemplate in theory these logical divisions than to make actual plans for altering the delivery system in metropolitan water districts. Political and economic realities restrict change in built-up areas unless the danger is severe, but in some new suburbs in Florida dual pipelines are laid for potable water inside the house and subpotable outside. Drinking bottled water is becoming more common. Many municipal water systems now supply partially purified (nonpotable) water to industry for cooling or other processes. Still, these new ideas have not been widely implemented to date.

It is unexpected, then, to find that the ancient Greeks had just such a triple system of water supply and reuse. Each Greek city had both public fountains and springs supplying flowing water of the best quality, and private cisterns in houses and public buildings to supply still water of good quality, plus a drain system that led used water outside the city. Wells were also used; those in the Athenian agora are typical for Greek technology, "ranging from two and one-half to thirty-seven meters, and averaging about 10 meters (32 feet)," whereas Solon's law said the digger could give up if he had not struck water at at 60 feet (M. Lang, 1968). When I first gathered the data, it made no sense to me that the Greeks would want spring water if they already had cistern water at home, or that each house had a cistern when there was running water at the corner fountain. Yet carrying water is laborious, especially if that supply is for all domestic use as well as for any artisan activities taking place in the courtyard of the house. Gradually I became conscious of how much work would be involved in hand-carrying all water. Still, it was not until I learned of the "6 percent" figure that I began to realize that it was worth the effort to carry enough fresh water for each meal, just as today people in small towns like Troy, New York, go to the local spring for water to make coffee or to dilute frozen juice concentrate. Friendly conversation at the fountain, while the modern plastic container or the ancient amphora filled up, could be a pleasant part of the daily routine. In the ancient cities, neighborhood wells served similar functions.

For most domestic and light industrial tasks, the cistern under each courtyard was the normal source of water. The rainwater that fell on the roof of an average house, if collected and stored in a cistern, was enough to supply all family needs for at least six months, even without special conservation measures, and without calculating the alternate supply of drinking water from fountains, springs, or wells (Judson, 1959, 27). During the wet months, the supply of water in the cistern would be alternately depleted and refilled; if the cistern were full when the rainy season ended, its six months' supply ordinarily carried the family through until the rains began again the following autumn. Some houses, such as the House of the Doric Capital at Morgantina, had two cisterns, effectively guaranteeing a full year's supply. Since the cisterns were cleaned out annually, the water in them was essentially clean and could be used for drinking and cooking if necessary. Placement deep in the earth kept the cistern water cool, and thus more palatable, but for most families the

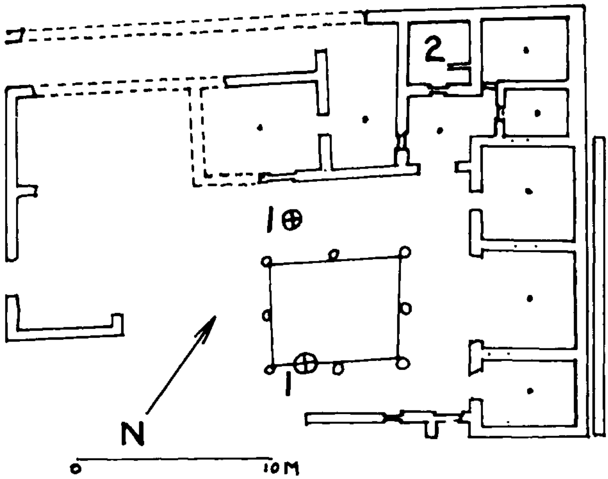


Figure 12.1. Plan of House of Doric Capital, Morgantina, with its two cisterns (1) and bathroom (2). Reprinted by permission of the present excavator, Malcolm Bell.

taste of spring water was preferred for drinking. "Subpotable" cistern water could be used for domestic cleansing and watering animals, and plants. If the family industry, such as making pottery, required water, the cistern could be tapped for that also. It seems likely that bathing, cooking, or laundry water was reused to flush the latrine or for some small-scale industrial processes. Such reuse would be somewhat more feasible for them than for us, as neither soap nor detergent was then in use.

USE OF WATER

There was an efficient grouping of water-use features of the house. Locating the cistern in the courtyard meant that this was also an alternate, logical place for the basin for washing hands, faces, and dishes. In Morgantina (as well as a number of other places) laundry also was done in the courtyard. Several houses there have a large hemispherical pithos located under a downspout that automatically filled the pithos with rainwater in the winter, and at Delos several low tub-with-scrub-boards lie in the courtyards where they would have been used (see Figs. 16.18, 22.9).

Used water and storm runoff were collected in sewers, to drain out through either slits in the ramparts or channels under the streets leading through the gates of the city. A letter from Hermann Kienast, excavator of the Samos tunnel and author of the study of the walls of ancient Samos, reminds me that thick stone or clay pipes were incorporated into the curtain walls to release water otherwise trapped inside the walls, and thus prevent collapse of the walls (Kienast, 1978, S.45 and Abb. 21). Nonpotable water, whether wastes or storm runoff, could be reused outside

Figure 12.2. Slit in ramparts near the postern below the House of the Official, Morgantina. Such slits permited runoff from inside the city to escape, possibly into an irrigation system outside, rather than build up behind the walls and endanger their stability. The slit is too small for anyone but a small child to penetrate, being approximately .3 by .6 meters.

the city all year long for irrigation. Growing wood for fuel and for building material would have been a high priority in the immediate vicinity of the town. The drainage system was completely gravity-fed, but some human manipulation of the water would have been necessary to allocate it for industry or in the fields for irrigation.

This system achieved high efficiency. For the provision and use of each quality of water, the minimum in human energy and economic resources was required, because for each arrangement maximum thought had been given. Fetching water from the fountain was in its way a social interaction, like buying and selling or exchanging views, and thus appropriate in or at the edge of the marketplace. Both the product—water—and the activity—fetching it—were refreshing and contributed to the quality of life that the Greeks valued. Between the domestic cistern and the public fountain, women as well as men could live pleasantly.

An unusual feature of these arrangements is that the time and effort of women and girls were considered valuable to the whole society, and worth utilizing efficiently. The cistern, an extremely cost-effective source of water in terms of human labor, was built integrally with the houses and maintained by the family. Water for the cistern was captured directly from the roofs without human effort, once the drainspouts were set in place.

However, for activities requiring larger amounts of water, efficient placement of the supply was the norm, just as we saw in the grouping of activities around the domestic cistern. The locations of springs and their associated fountainhouses determined the placement of the agora, the sanctuaries, and other nodes of activity—the ancient equivalent of the central business district.

As a modern person, my standards for sophistication and elegance in urbanization include provision of water supply and drainage. When we see that even small towns like Morgantina made the necessary expenditures of thought and money to provide drains from every house into the sewers of the street, it is reasonable to infer that constructed drainage was the norm in this culture. From the neighboorhood street drains, larger channels led to the nearest exit from the city, rather than allowing liquid wastes to accumulate close to the houses. If this latter pattern had been the norm—as has all too often been the case, in nineteenth century London or twentieth century Calcutta, for example—it would be evident centuries later during excavation or urban renewal, as when the stinking moats of Istanbul were cleared out during the 1980s and were made into a public park.

EXAMPLES

Two ancient cities that had water systems that allocated different qualities of water to different uses may be examined to make our study more vivid and more specific. They are Selinus on the south coast of Sicily, and Priene, an Ionian Greek city on the west coast of Asia Minor (see maps, Figs. 3.1, 12.3, 12.4).

Selinus flourished on the agricultural wealth of the surrounding plains and on trade with Greece, Carthage, and Rome as well as with natives of the interior. Before we examine the water management of Selinus, let us make a rapid survey of the topography and chronology of the city (Martin, 1975, 54–67; Theodorescu, 1975, 108–20). Selinus was a very large city of several districts, although this fact is not easy to grasp when visiting the site. At the site's center lies a headland, running perpendicular to the sea between two rivers. The only part extensively excavated is the Acropolis with its group of temples, agora, and residential area (Fig. 12.5).

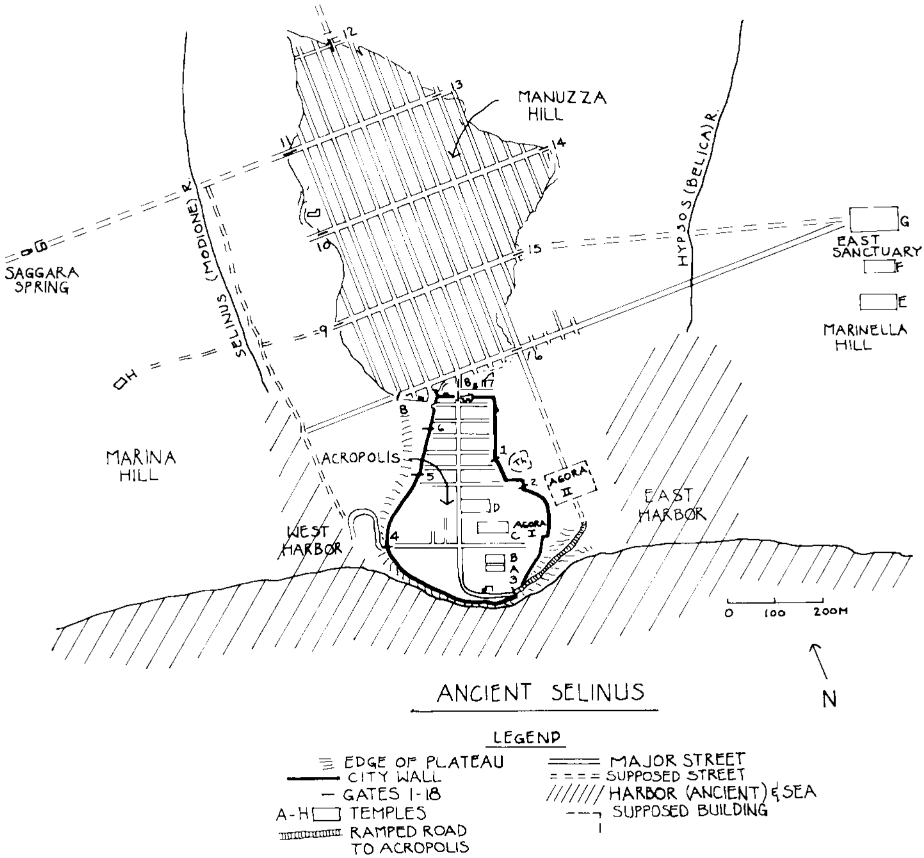
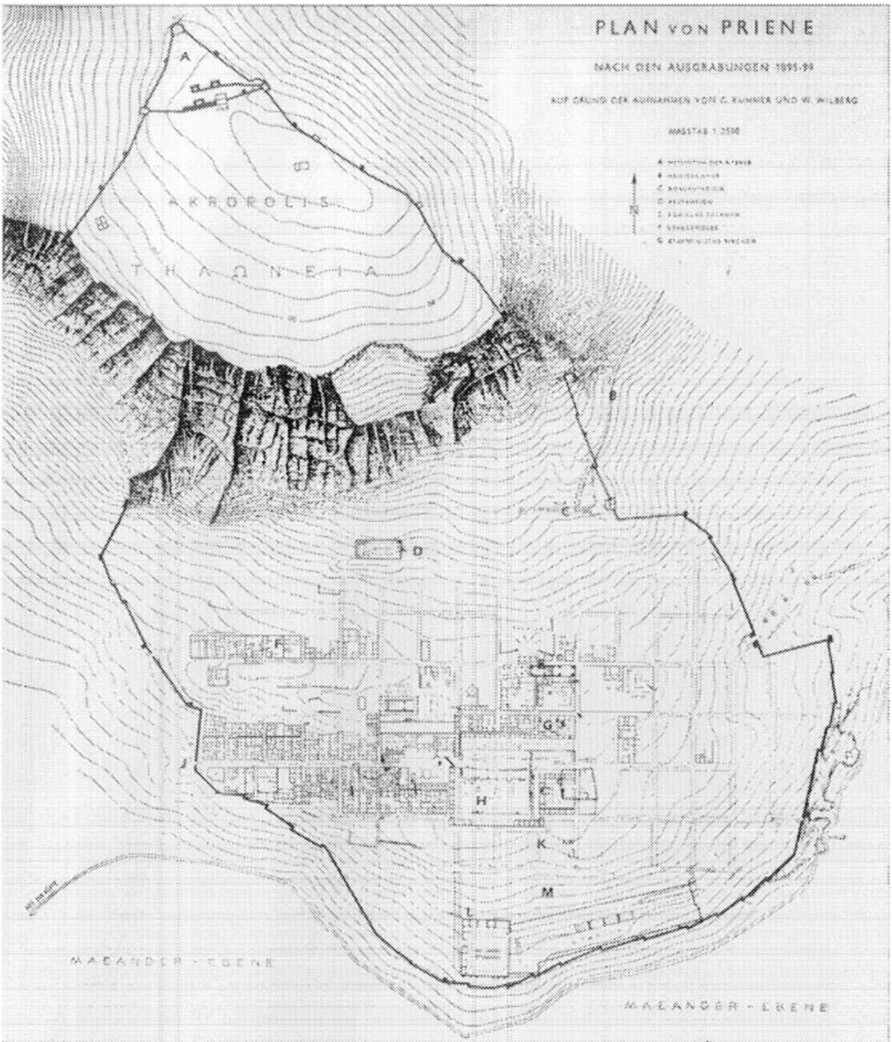


Figure 12.3. Map of Selinus area, with ancient coastline and built-up areas.

Figure 12.4. Plan of Priene, by Kummer and Wilberg, 1885–89. From top to bottom: *A.* Acropolis where a reservoir was fed by lead pipes from an aqueduct tapping karst springs in the marble mountain. *B.* Waterline crossing the city rampart on the east. *C.* Series of tanks and reservoirs for the town, supplied by aqueduct B. *D.* Demeter Temple, supplied with water from a vein in the mountain here, with additional water from roofs and from spring overflow, held in large and small cisterns. *E.* Roman bath, just below the theater. There are fountains, cisterns, and other water system elements along the street between the bath and theater. *F.* Houses at the left, on the same street, were supplied by pipes that tapped directly into the slope behind them, and also had street fountains to draw on. *G.* Lower than the terrace of the Athena Temple but higher than the North Stoa of the Agora, the Prytaneion had its own fountain and cistern (see Fig. 12.6) *H.* The Agora is discussed and shown in detail in Fig. 14.1. *I.* Houses to the west of the Agora were mostly supplied with water in pipes, but about 25 percent of them had cisterns. Their toilets and stables sometimes shared one space. *J.* The waste water channel at the edge of the main street of the town terminated in a



gate at J, where it poured into a karst shaft (indicated as Sump on figures 12.6 and 12.7), as it still does, and was led away underground. *K,K.* Drains from the Agora and its neighboring streets were led down the steep slope between the agora and the stadium below. *L,M.* At L the palestra with school rooms and bathing room, and at M the stadium below a cave-spring. Like the stadium at Delphi, this one was located to take advantage of an ancient spring. When I was there in 1988, the spring had been newly cleared. Water from this spring supplied the bathing room in the palestra to the left of the stadium; the bathing room is located in the northwest corner of this complex, and is marvelously well preserved. (See Fig. 16.10.) *N.* Spring outside East Gate, connected with the Agora by a stepped street. At the bottom of the plan, the word Meander appears twice, showing the bed of the present river; in classical times, an arm of the sea separated Priene from its neighbor Miletus to the south and justified the placement of Priene high on its terrace, above storms and sea-borne attack. Reprinted by permission of the German Archaeological Institute, Istanbul.

Colonists from Megara built the acropolis sanctuary (planned not later than 570–560 B.C.). They laid out a wide north-south street and the two east-west streets perpendicular to it, flanking the acropolis sanctuary, a band of public space across the widest part of the headland. Selinus is an example of the most common urban plan of the seventh and sixth centuries: one long straight street as the axis of the site, with cross-streets perpendicular to it, which we have called the Posedionia (Paestum) plan (see Chapter 5 and Fig. 5.1).

To the east, across the river, stood three more large temples and some houses. Pre-Greek occupation of Selinus is known only on this hill. Wharfs, warehouses, and residential quarters occupied the banks of the eastern river. A similar pattern prevailed on the slopes of the river to the west of the acropolis, though for sanctuaries there were only two small temples built on the far side of this river. To the north of the acropolis, a narrow neck of land connected that headland with a plateau today called Manuzza, stretching to the northwest; this was the prime residential area of the city, and some excavation has been done here. The cross streets of this sector terminate at the points of easy access to the plateau, and align with the axis from Temple M on the west hill, which was a very early focus of settlement, probably because of a major spring, to be discussed later.

After 408 B.C. the population changed from predominantly Greek to more strongly Punic—but the Hellenic influence in this part of the Mediterranean had been so strong for more than 300 years that the new settlers were Greco-Punic in culture. For about a century and a half they enjoyed the natural and commercial advantages of the site, probably utilizing the same sources of water. Then in 252 B.C. the Romans conquered Sicily but did not occupy Selinus; in fact, there is little evidence of any later occupation, which undoubtedly has been the chief factor in the preservation of the site.

In our other example, Priene, we find many contrasts of date, plan, scale, location, ethnicity, topography, geology, and position in the sequence of city planning history, as compared with Selinus. The original site of Priene is unknown, though it supposedly was founded from Thebes, perhaps during the wave of migration from the Greek mainland around 1000 B.C. (Stillwell, MacDonald, and McAllister, 1976, 737–38). The citizens of Priene fought in the Persian Wars of the early fifth century, but the city's small contribution in ships and men indicates that it was never a large place. Apparently the original city suffered severely in these wars, possibly to the extent of being razed and depopulated. (I suggest looking for the earlier Priene somewhere uphill and inland from the present site.) It is possible that changes in the water supply may have contributed to the decision to move downhill, if the water naturally cut itself lower and lower channels. Priene was in classical times a seaport, but the silting up and delta-building of the Meander River gradually changed the terrain and altered the available resources of the city. The city, north of Miletus, across the Meander River, was rebuilt on a plateau between the plain of the Meander and a nearly perpendicular cliff upon which stood a fortress and acropolis for the city. The plateau sits safely above the flooding of the Meander, which still troubles Miletus, and consequently well above the early arm of the sea which was both the opportunity and the danger for this small community. Today the site is about 12 kilometers inland and has no harbor. In the fourth century Priene was refounded on its present location—"the most spectacular [site] in Ionia" (Stillwell, MacDonald, and McAllister, 1976, 737–38)—where earlier Naulochos, the harbor of Priene, seems to have been located. This happened just as the Carthaginians were taking over Selinus, but Priene survived almost half a millennium longer. In plan, the fourth century city was a checkerboard with Agora at the center. Our maps (Figs. 12.6, 12.7) show how the water supply and sewers of the city conform to the checkerboard plan.

A word on the geology of the two cities. Selinus lies in a zone of calcerous rocks, layered with sandy-clay, good for the collection and availability of potable water. The most notable spring at the site is Gaggera on the west hill, near Temple M (which had so much impact on the street pattern of the Manuzza plateau). This spring, when measured in 1965 and 1966, gave between 1.6 and 2 liters per second, depending on the season (Dall'Aglio and Tedesco,1968,171–210). Since such a flow would not be enough to supply the very large city that Selinus became, we need to look inland for additional sources, possibly the spring near Castelvetrano. The pressure line that can be inferred from the lockstones found at various places on the Selinus acropolis, but not as far as I know reported in the literature, probably took its origin from this spring.

Priene's geology, though quite different, was equally amenable to exploitation for human settlement. The geomorphology of northern Ionia is characterized by a series of river deltas cut through crystalline rock structure, while from Izmir south there are varieties of karst in the mountains of limestone and marble. At Priene in the southern region, the massif is of marble above schist. Enough water percolates through fractures in the marble and comes to the surface as springs to ensure the greenness of Priene even in August. The absence of cisterns in the ancient houses suggests that the supply of flowing water was sufficient for all uses. A pressure pipeline (lead) supplied the acropolis. From it the water went to the collection tanks just inside the eastern wall of the city, above the houses, and the water was distributed by gravity flow. At the foot of the site today, water from a line that comes around the right shoulder of the hill supplies the small village before gushing into the pool in front of the tourist restaurant.

In spite of the striking differences between the two cities, we find in them many of the same water system elements that were everywhere characteristic of the Greek world: fountains; pipes, channels, and drains;

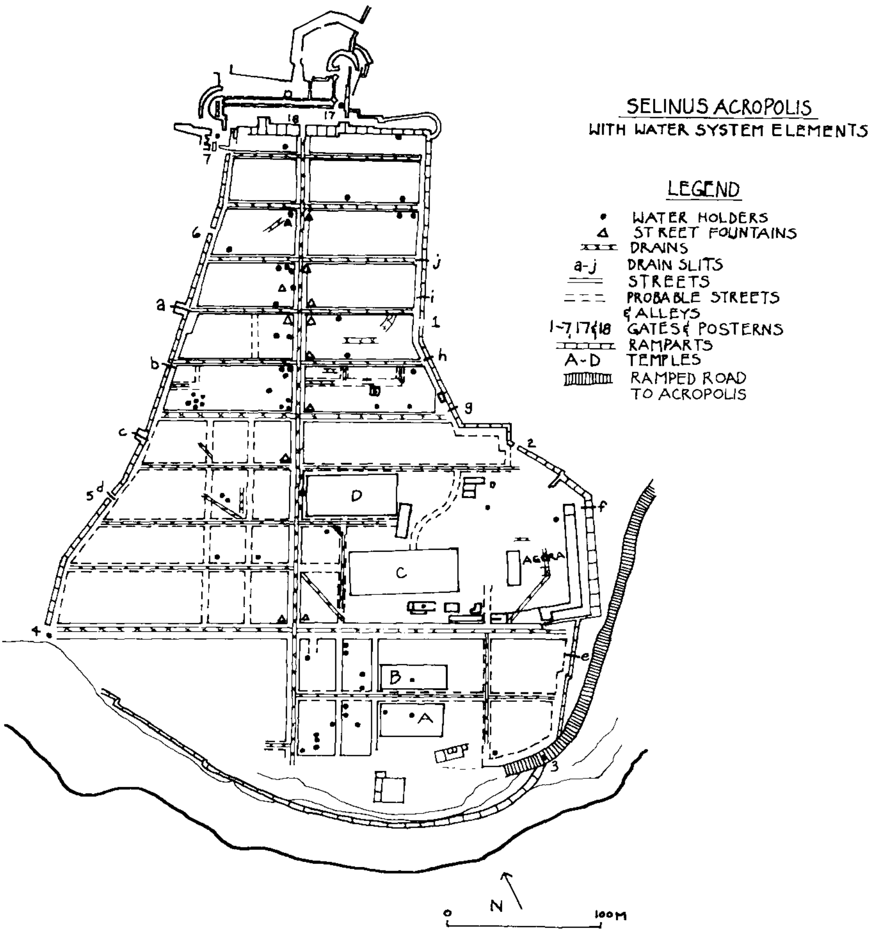
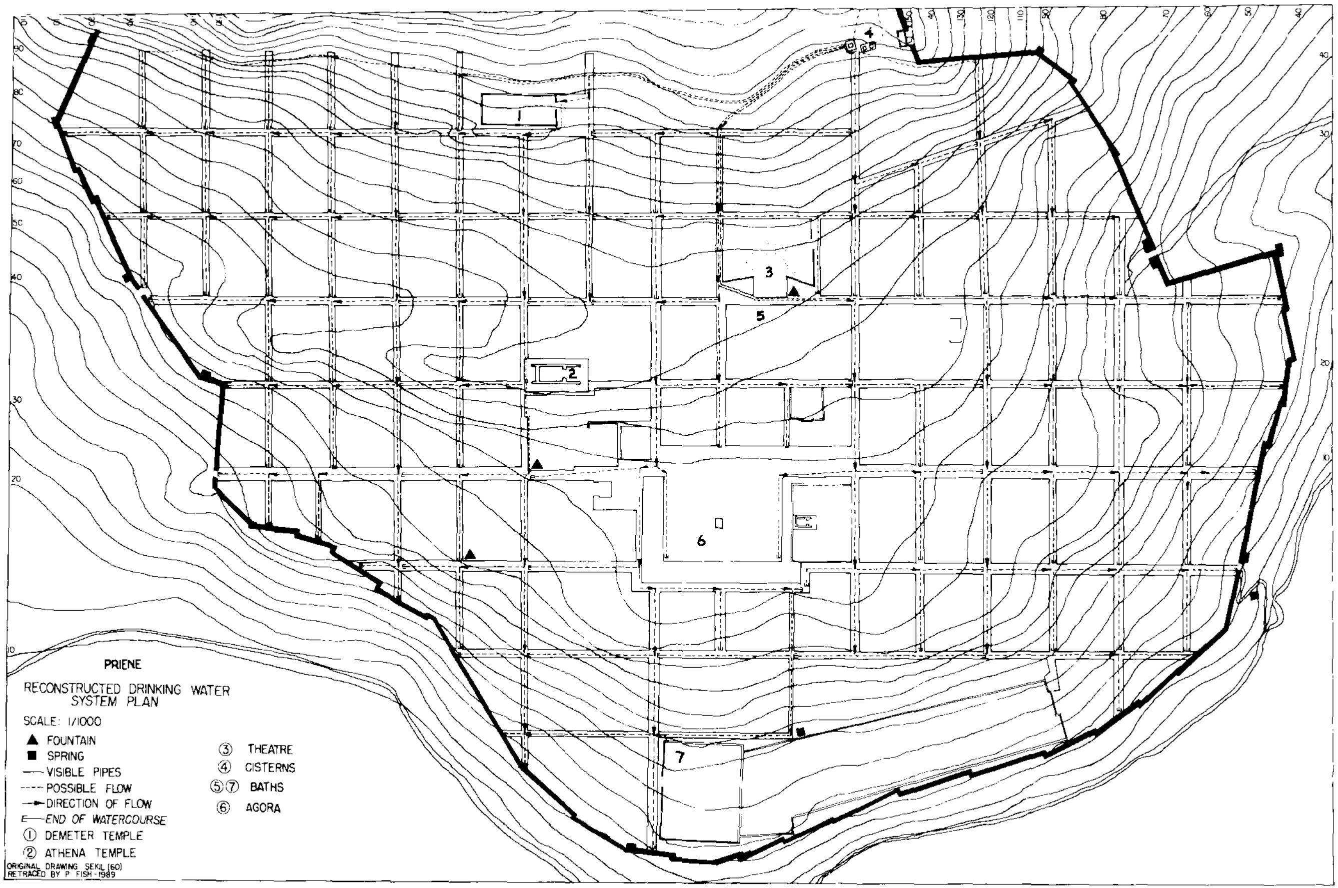


Figure 12.5. Map of Selinus Acropolis with water system elements. Water holders may be wells or cisterns, and are distinguished from fountains, which received flowing water from pipes.

bathrooms and their fittings; water storage. The elements are physical manifestations of the traditional knowledge and social behavior for finding, transporting, and using water, for distinguishing between different

Figure 12.6. Plan of pipes of drinking water system, Priene. Springs, fountains, and sump added by the author. Based on a study by Sekil, a graduate student of Professor U. Özis at the Dokuz Iylul Technical University of Izmir, Turkey; in turn based on earlier work of Wiegand. As published by Reimer Verlag, Berlin, in Wiegand et al, *Priene*, and reprinted by permission of the German Archaeological Institute, Istanbul.


PRIENE
RECONSTRUCTED DRINKING WATER SYSTEM PLAN
SCALE: 1/1000
FOUNTAIN
SPRING
VISIBLE PIPES
POSSIBLE FLOW
DIRECTION OF FLOW
END OF WATERCOURSE
① DEMETER TEMPLE
② ATHENA TEMPLE
③ THEATRE
④ CISTERNS
⑤⑦ BATHS
⑥ AGORA
ORIGINAL DRAWING SEKIL (60)
RETRACED BY P FISH-1989
1
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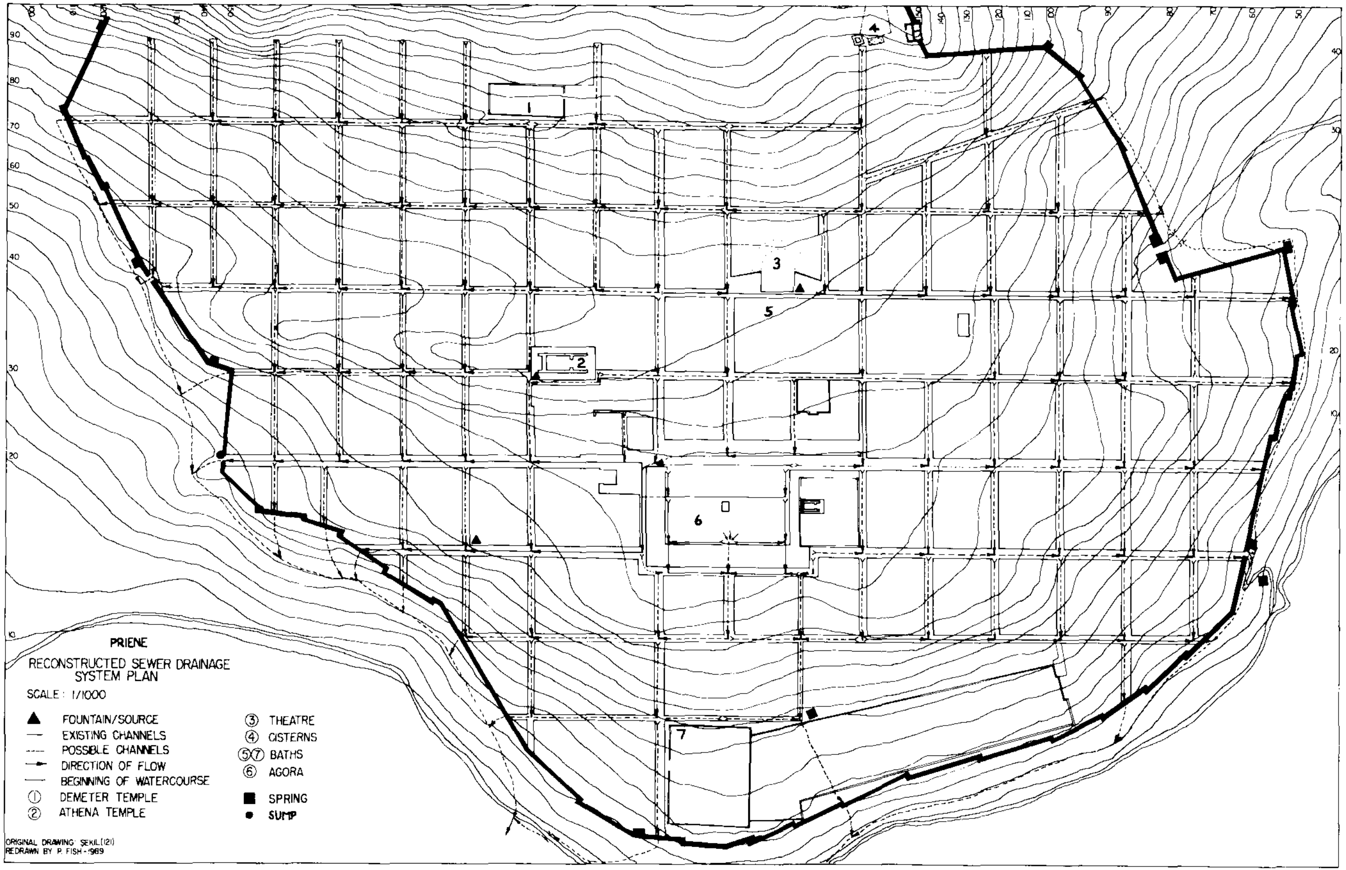
PRIENE
RECONSTRUCTED SEWER DRAINAGE SYSTEM PLAN
SCALE: 1/1000
FOUNTAIN/SOURCE
EXISTING CHANNELS
POSSIBLE CHANNELS
DIRECTION OF FLOW
BEGINNING OF WATERCOURSE
1 DEMETER TEMPLE
2 ATHENA TEMPLE
3 THEATRE
4 CISTERNS
5 7 BATHS
6 AGORA
SPRING
SUMP
ORIGINAL DRAWING: ŞEKIL (121)
REDRAWN BY P. FISH - 1989

grades of water, and for reusing and disposing of water economically and prudently. To enumerate the water system elements of each city and set them in relationship with one another, we are forced to use inaccurate and incomplete data since neither site has been excavated for the purpose of understanding the whole water system. Nevertheless, by bringing the available evidence into juxtaposition, we can glean from it some useful insights (table 12.1).

It may be easier to comprehend these water system elements if we classify them according to their functions, dividing them into public amenities, infrastructure, and domestic use (tables 12.2–12.4).

A few comments on these entries will help to put the data in perspective. Both cities relied more than other places on piped water; Delos, for instance, relied much more on cisterns and wells for domestic water than either of these cities did. Wells and cisterns are known at Selinus, but not evenly distributed across the site, so far as we now know. Since the excavated acropolis at Selinus was not as heavily settled as the north plateau which is almost unexcavated, the pattern of distribution of water system elements will undoubtedly seem quite different once excavation has revealed more of the prime residential area. Both Priene and Selinus utilized holding tanks, reservoirs or surge chambers. Three springs are known at Priene, but only one at Selinus. At least one formal public fountain was found at Selinus and perhaps as many as three, while sixteen waterbasins were placed along exterior house walls on the cross streets of the acropolis area. At Priene we know of six public fountains and three basins. Although pipes have been found in at least eight locations at Priene, including 20 or 30–foot runs of pipes under Spring Gate Street (Wiegand and Schrader, 1904, 68–80), I saw only two individual pipes at Selinus. However, the presence of four lockstones there suggests that one long-distance water supply line had been a pressure pipe of metal now robbed out. Priene had a pressure pipeline connected with the water chamber high on the acropolis, with at least one lead pipe found there (Wiegand and Schrader, 1904, 72). Both sites have numerous channels and gutters, but Selinus has manholes for access to underground lines. Since the two cities flourished at different times, it is not surprising that their washbasins and tubs were of different shapes. Such shapes changed every century and a half or two centuries during Greek times (Ginouves, 1962). It is interesting that in the late Greco-Punic houses that invade the

Figure 12.7. Plan of channels of sewer system, Priene. Note sump at west end of main street, which was probably a karst shaft utilized for drainage. Springs, fountains, and sump added by the author. Based on a study by Sekil, a graduate student of Professor Özis at the Dokuz Iylul Technical University of Izmir, Turkey; in turn based on earlier work of Wiegand et al., *Priene* (ibid.). Reprinted by permission.

Table 12.1
Water System Elements at Selinus and Priene

Element	*Selinus*	*Priene*
Cistern	16	4
Tank	2	3 "surge chambers"*
Well	1	1
Spring	1	3
Fountain	1	6
Waterbasin	16	3
Pipe	1	8
Pressure pipe	possible	1
Stone pipe	4 lockstones	2
Lead pipe	possible**	1
Drain	35	9
Channel gutter	19	yes, not counted
Manhole	2	unknown
Bathroom	several	2
Public bath	unknown	2
Tub	6	3
Washbasin	2 types	1
Latrine	1	3
Slabs over drain	yes	yes
Well/cistern head	3	1
Spout	unknown	1
Drain slit	10	3
Settling basin	1	1
Laundry basin	unknown	unknown

*Surge chambers are tanks that receive water from a pressure pipeline, allowing the pressure to escape harmlessly into the air before the water is drained into another line of pipes (see Hodge, 1990).

**I saw a doorsill with a 2 inch hole, just the right size for a lead pipe.

"Unknown" means that I did not see them and have not found them in the literature.

Table 12.2
Public Amenities

Element	*Selinus*	*Priene*
Fountain	1	6
Water basin	16	3
Public bath	unknown	2
Public latrine	1?	3?

Table 12.3
Infrastructure

Element	*Selinus*	*Priene*
Spring	1	3
Pipe (terra-cotta)	1	8
Pressure pipe	possible	1
Lead pipe	possible	1
Stone pipe	4 lockstones	2
Drain	35	9
Slabs over drain	yes	yes
Drain slit	10	3
Channel, gutter	19	yes
Manhole	2	unknown

Table 12.4
Domestic Fittings

Element	*Selinus*	*Priene*
Cistern	16	4
Tank	2?	3?
Well	1	1
Bathroom	several	2
Tub	6	3
Washbasin	2 types	1
Latrine	1?	3?
Well/cistern head	3	1
Settling basin	1	1

sanctuary area at Selinus there are standard Hellenistic bathtubs, and yet no evidence of typical stemmed washbasins.

Few recognizable latrines survive from either city, although that may be explained at least at Selinus by the fact that domestic bathrooms included a space separated from the rest by a half-wall, and drained to the sewer in the street (Fig. 20.11D). I think that people urinated here, using dirty bath water to flush the floor through the drain, and that excrement was deposited in portable chamber pots, for collection and distribution as fertilizer on the farms outside the city walls. In other words, we see that not every human activity has a corresponding *architectural* solution. In both cities, channels at one edge of the street carried waste and rainwater toward the gates or toward slits in the ramparts, and thence out to the fields or nearby rivers (Fig. 12.7).

RESOURCE CONSTRAINTS

Priene and Selinus have representative, not identical, examples of the standard water system elements known in the Greek world, employed prudently because of their resource constraints. What constraints did these ancients have to consider? Was there any similarity in their situation to those that impel us to experiment with three-tiered water systems? To put the Greek situation as simply as possible: First, in their climate the heat of summer makes ample water supply essential, just at the time of year when there is no precipitation. Water must be saved and carefully managed to last through the summer. Second, they relied on human and animal rather than mechanical or fossil fuel energy for the execution of work. Third, the gradual deforestation of the land resulted in scarcity of fuel for cooking and heating and of building materials. Some of this deforestation was integral to the karst process (Bintliff, 1977, 50ff; Chapter 7 here), but deforestation could be aggravated or ameliorated by human behavior such as over harvesting wood close to a city or, on the contrary, carefully reforesting.

In response to these constraints, the Greeks had learned to locate water sources and to place their settlements nearby, as we have seen in the case of the Gaggera Spring at Selinus. Later they conveyed water from distant sources to existing cities (Fahlbusch, 1982, 34–41) to supplement springs, wells and cisterns at the site, as was the pattern at Priene. Thus they developed a plurality of supply, ensuring the security of the community by not relying on only one source for so crucial a resource as water. To complete the ecological loop, they learned to drain waste and storm waters away from the city for use in fertilizing and irrigating crops, whether food or trees. Reuse of waste waters immediately produced more food and also replenished the water table so that the wells and springs continued to flow for their children and grandchildren. This is resource management—inferred from the resulting duration of urban life— on a fifty to one hundred year cycle, as is the growing of trees, and speaks to us profoundly—if we will listen—about the values of their culture. When we see that the cities endured upwards of four hundred and fifty years, we ask, How was it done, given the constraints of the geography and of human nature? What would we have to do to sustain a settlement here? The constraints, as we have seen, dictate the solutions. The Greeks knew how to conserve water for both public and private use, by storing it as close as possible to the point of use, covering channels, and diverting the excess from their ever-flowing fountains to the reuses mentioned earlier.

The crux between supply and discharge was usage. Here the ancient Greeks differentiated as a matter of course between three qualities of water. First-quality water was available in both Selinus and Priene for drinking. The subpotable water of cisterns was used at Selinus for noningestive domestic activities. At Priene, because of abundant flow of water from the mountain, there was no need to distinguish so clearly between potable and subpotable water uses, so that at least some of the subpotable activities were handled by public installations such as the two large bathing establishments, and some were supplied by drinking-quality water from pipelines, as we do today. Cooking, laundry, and bath water could be reused to clean floors and then to flush latrines. Reused water and the runoff from storms was collected in drainage channels and pipes, to be used for irrigation—the ancient equivalent of the nonpotable water that our systems supply for industrial use and irrigation. Even here, however, the 25 percent of the houses that were placed at the outer edge of the plateau are those where cisterns are found; separated from the abundant resurgences of the cliff face, this group of houses had to rely on saved rainwater for many domestic uses.

Thus the evidence from two ancient Mediterranean sites verifies the insights of modern hydraulic engineering, and these insights in turn explain the otherwise contradictory evidence from Greek water management. Given the principle of allocating three appropriate qualities of water, the ancient Greek evidence falls into a coherent pattern, parallel to the most modern ideas. What grim necessity forces certain modern cities to arrange for their survival, similar pressing necessity induced the ancients to organize some 2500 years ago. We had forgotten a great deal that we now rediscover with difficulty. The nineteenth century cost-benefit analysis that decreed one kind of water—potable—for all uses is now being seriously questioned on both economic and medical grounds. It is time to rethink the best uses of our resources, time to look again to our predecessors the ancient Greeks.

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