Aquae Urbis Romae: The Waters of the City of Rome

KATHERINE WENTWORTH RINNE
Massachusetts Institute of Technology

INTRODUCTION

Aquae Urbis Romae: the waters of the City of Rome examines water as a living system related to the 2800 year history of the urban development of Rome. At the most basic level it is a map that physically locates over 800 individual pieces of hydrological data in a straightforward, easily comprehensible format. Additionally it is an interactive, worldwide-web based historic and cartographic research archive for architecture, landscape, planning, urban design, and history students, as well as students in the related disciplines of geography, archaeology and engineering. While the ostensible goal of the map is to graphically reveal the hydrological history of Rome, a further goal is to encourage a level of urban analysis, based on an acknowledgment of natural forces and processes as they impact cities. Using Rome as an example, *Aquae Urbis Romae* asks the student to consider the intimate relationships that exist between water, gravity, and topography, and the dynamic between natural water systems, (i.e. the existing hydrological structure of the landscape) and the delivery, distribution, use and display of imported water systems as they influence urban growth and form.

WHY ROME?

Rome was chosen as the focus of this study for four reasons. First, Rome is used as a laboratory by hundreds of American design and history students every semester, who at any given moment are dissecting, drawing, designing and delighting in the city. Aquae Urbis Romae is intended, first and foremost, for them. Regardless of the pedagogical goals of individual programs as divergent as RISD, Notre Dame, Cornell, and Arkansas, the hope of administrators and faculty is that students will learn to learn from history, and that they will question what they have learned in the future. We take our students to Rome because it is a 2800 year model of urban and architectural experimentation against which they can test their ideas. The goal of the Rome experience is not to teach them to copy Michelangelo or Bernini, but to understand through them how to evolve a philosophy of design that is meaningful and responsible today. The goal is not to encourage them to impose the Piazza Navona on Louisville or Lakewood, but to understand what it means to create a public place in the city that embodies and expresses the exciting interplay of policy, landscape, economics and culture as well as scale, texture, material, light, and people.

Secondly, Rome was chosen because water is a profoundly important component of its form, history, experience and mythology, and because it has one of the longest continually functioning water infrastructure systems in the world. This includes not only tectonic elements such as the sewers, aqueducts, wells, conduits, cisterns, and fountains, but also the dynamic natural elements including the Tiber River, springs, streams, marshes, floods, and rainwater all linked through topography. Together these elements weave physical and spiritual threads through spatial, social and historical spheres of the city, and translate the hydrological system, through imagination, time, circumstance, and gravity into the specifics of place. One purpose of the study is to demonstrate how this hydrological complex impacts the public life of Rome and structures the larger landscape of streets, piazzas, markets, neighborhoods, and parks. Through example it suggests that all cities, from Minneapolis to Marrakech, and Seattle to Soweto are subject to the same complex interplay of hydrological forces. The third reason I chose to study Rome is because it fills me with a profound sense of joy which I knew would sustain my interest throughout the long ordeal of research. The fourth and final reason is because, remarkably enough, there is always something new that can be said about Rome.

WHY STUDY WATER?

Water in Rome, as in any other city, is a coherent urban system — one of the multiple "grids" of public infrastructure that, like roads unite with topography, as significant determinants of city growth, and urban form. Unlike roads which are generally visible in their entirety and hence easily comprehensible, much of the infrastructure of water is hidden underground. Therefore, although water is one of the basic building blocks of the city it is largely unknown, misunderstood, and ignored by designers, administrators and the public. *Aquae Urbis Romae* reveals this hidden infrastructure through time and type in order to begin to fill this lacuna in our understanding of the city. The study demonstrates how an analysis of infrastructure can lead to a clearer understanding of urban history and form. By examining Rome or any other city, through its water infrastructure students gain a richer understanding of urban form, history, and technology, and are able to ground their theoretical and design work more fully in the context of the city — they are able to see the city as a network of linked forces, which in turns brings a deeper understanding of the specifics of individual neighborhoods and places.

One advantage of studying water as it relates to the process of urbanization is, as Dora Crouch points out in *Water Management in Ancient Greek Cities*, is "that the behavior of water, and therefore to a large extent the management of water, are 'culture free,'" and "therefore much less conditioned by human preference" than social practices or architectural styles, etc. Water responds to the same physical laws in Rome as any other place in the world, and serves precisely the same functions — drinking, bathing, cooking, growing crops, tending animals, and also ritual and industrial uses. Therefore the insights gained through this project, should be equally applicable elsewhere. One has only to read the newspaper accounts of ethnic

struggle in Turkey, Iraq, Eritrea and elsewhere, to know that the issues related to the exploitation, development, manipulation, abuse, and struggle to control and distribute water resources that were experienced by the ancient Romans are precisely those that we experience today. Water, more than any other resource, will be **the** subject of the 21st century. Therefore we must understand how this natural system, which is a primary repository of political and economic power, impacts design decisions and what we as designers can do to have a positive impact on water policy at the scale of the building, the block, the neighborhood, the city and the region.

WHY A NEW WATER MAP OF ROME? AND WHY MAKE IT INTERACTIVE?

The first reason for making a water map of Rome is simply that one does not exist. And, by making it interactive it is possible to study this complex hydrological system in linear and lateral modes including: typologically (aqueducts, fountains, floods, sewers, water-driven mills, etc.); topographically (the Roman Forum, the Campus Martius, Trastevere, the Borgo, etc.); and chronologically from approximately 800 BC to the late 20th century. Nearly two hundred completely new computer maps were created for this project. This material is supplemented by historic photographs, maps, prints and texts. Contemporary topographic levels are included at one meter intervals for the intramural city, and all typological and hydrological data is referenced by elevation, as well as location. This allows for the study of water movement through the city. Information can be refined and updated as modern excavations reveal new data, and as the city itself makes changes to its infrastructure system.

There are five ways to navigate through the site: typology, chronology, topography, text and image.

1) The typology section allows the user to create his or her own map by choosing up to three layers of typological data to overlay on any one of three base maps. Ultimately there will be more than one hundred typological categories from which to choose. Examples of possible choices include: ancient aqueducts; ancient sewers; modern aqueducts; the distribution network of the Acqua Vergine in 1575, or its distribution today; all the public fountains in the Acqua Felice system; all public fountains commissioned by Pope Sixtus V, or all those commissioned by Mussolini; all public fountains designed by Bernini or Giacomo Della Porta; or all the water features sponsored by Agrippa, etc. Any combination of layers is possible. Once the three layers have been selected they can be viewed on one of three base maps: 1) hydrological setting including the Tiber river, springs, streams, and marshes (default), 2) hydrological setting with modern city streets and blocks, or 3) hydrological setting with contemporary one-meter topography. This feature allows each student to construct a map that is related to his or her specific research needs.
2) The chronology section allows the student to follow the hydrological development of the city through a series of time-line maps from 753 BC to the present day. Each of the fifty "pre-cooked" maps covers a specific moment and shows existing features, and highlights new features. Some time-line maps cover several hundred years while others cover a period of only a few years. This reflects the amount of documented hydrological change. For example, the map "Early Republic" begins in 312 BC, the year that the first Roman aqueduct was built. Little activity has been documented for the medieval period. Therefore the entire 900 years is covered in only three maps. However, the 50 year period from 1572 - 1622 was one of the most active in terms of changes to the Roman waterscape and is covered by three timeline maps, each referring to a specific pontificate: Gregory XIII, Sixtus V, and Paul V. Each of the fifty time periods can also be viewed on any one of the hydrological base maps as described in the Typology section.
3) The topography section provides access to a three-dimensional topographic model which is sampled at a vertical resolution of one meter and scaled 3:1 for clarity. However, in the CD-ROM version (also currently under production) it will be possible to view it at any vertical dimension. The model allows the user to examine the topographic relationships between disparate areas of the city, and to understand the dynamics of the hydrological system. Any of the "pre-cooked" time-line maps and any of the personalized typology maps can be viewed as "Quick Time" movies or in Virtual Reality.
4) and 5) The text and image sections allow the student to go directly to selected primary and secondary, literary, visual, and archaeological sources, and to link directly from the text to the cartographic data. Primary data includes Latin texts and English translations, such as *The two books on the water supply of the city of Rome*, by Sextus Julius Frontinus of 97 AD. Primary visual material include historic photographic and printed resources such as the 1675 engravings by Gianbattista Falda, *Le Fontane di Roma* and the 1923 photographic collection of Giuseppi Magni. Secondary sources include difficult to obtain studies such as *Sulla fognatura della citta di Roma*, by Pietro Narducci, which is the major study of ancient Roman sewers and includes a series of important measured sectional drawings. Other documents and images, such as the aqueduct drawings of Piranesi, are added as they become available from the collections of various collaborating archives and libraries. Another feature is a search engine, still under construction, which will allow searches for specific hydrological features (Trevi Fountain), topographic elements (Caelian Hill), patrons (Pope Nicholas V), designers (Gian Lorenzo Bernini), authors (Sextus Julius Frontinus), or subjects (Gravity Flow Water Distribution).

The text resource will also include a journal, *Aquae Urbis Romae* which will premiere in Autumn 2000 as a refereed, on-line publication. A multi-disciplinary journal of Roman water studies, the first issue will include articles by an archaeologist, a landscape historian, an urban designer, a geographer, and an architect, with articles on water distribution in Republican Rome, the fountains of the Acqua Vergine network, the social role of water in Baroque villa gardens, Roman water law and its impact on current planning policy, and a series of recent design proposals for the Tiber River embankment. It will also serve as a showcase for current student design work that addresses the subject of water in the city of Rome. The on-line journal is one of the most exciting aspects of this project because it will bring together a large body of related work from several disciplines, all focused on Rome. Furthermore, as an on-line publication much of the lag-time and high costs associated with print will be avoided, hence facilitating publication of timely research and design projects.

WHY IS THIS KIND OF RESOURCE IMPORTANT FOR STUDENTS, AND HOW WILL IT IMPACT THEIR RESEARCH AND DESIGN WORK?

As I have mentioned *Aquae Urbis Romae* is more than simply a tool for understanding Rome. It is also intended to suggest a strategy for looking at other cities. It is not intended as an end in itself, but literally as a "jumping off place" for further research and analysis by others. How will this happen? 1) This study engages most of the disciplines that fall under the rubric of environmental design, i.e., architecture, landscape architecture, urban planning and design, and architectural, landscape, and urban history, as well as the related disciplines of art history, cartography, hydrology, geography, archaeology and classics. 2) It will form the basis for a general knowledge of the urban development of Rome by examining how water, **the** most essential element for human survival and the growth of cities is exploited, controlled, and manipulated for political, social, cultural, religious and other goals. 3) It will provide a general understanding of how infrastructure provides a continuous temporal

and physical thread for expanded urban awareness. Unlike roads and parks which are fully revealed as elements of the urban infrastructure, the hydrological infrastructure is merely referenced by the occasional public fountain, a fire hydrant, or a sewer drain. To the informed student and practitioner these elements will not only allude to infrastructure, but will provide clues about the entire city, and create a heightened awareness of the inter-connectedness of every element of the hydrological system.

4) Because it provides a new way to formulate research and design questions through topographic studies, it will help develop new strategies for solving research problems. Urban relationships that had not been previously apparent are revealed in a manner that forces urban questions to be reframed. Instead of first asking how a particular feature is unique to its site, rather, one asks how it is connected to the rest of the city. 5) It offers another possibility for students to increase familiarity with a digital resource through use and potential collaboration. It engages questions of how a digital archive is made, how it is used, and how to go forward with it. 6) In addition to the web site the data will also be available in CD-ROM format. This will provide access to topographic data for the entire intramural city including: real world positions; topographic modeling at one meter intervals; the ability to locate individual feature elevations; the ability to cut sections anywhere in the city; the ability to link to other GIS data; and the ability to add new layers of data as needed for personal research. Once the material is available on CD-ROM it will be possible to download the data at a usable scale for research and studio use, and to plot accurate, large format maps. It will be possible for each student to build his or her own layers of related data directly onto the map and construct an individualized research itinerary.

CONCLUSION

Although it may seem that elaborate declarations are being made about the importance of this work, in fact *Aquae Urbis Romae* is a simple research tool. I am merely suggesting that by locating and physically mapping all this related information in one place that new questions begin to arise about the city of Rome, and that many of these questions could also be asked about other cities if we took the time to look at the data in new ways. I will cite two example of new questions, both evolved from the same data, that have occurred to me in the process of creating this archive — one is a design question and one a question of cultural and social history. Then I will just mention one area of urban design that will be profoundly enriched by a general awareness to the dynamics of hydrological history.

1) By simply locating each of the Roman fountains, connecting them to their conduits, and identifying their topographic relationship to their aqueducts, (i.e. distance from their water source, elevation of the piazza in relation to the elevation of the aqueduct, and amount of water flowing to each fountain, etc.) it became clear that previous analyses of the fountains, of which there are many, have all overlooked the topographic and hydrological relationships between fountains. By examining fountains as elements of gravity-driven aqueduct networks set within a specific topographic setting, the data demonstrate how an understanding of the relationship between topography and gravity preceded other design considerations, and helped to establish a distinct identity for fountains within a particular "watershed". For example, two fountains by Bernini, the Triton and the Quattro Fiume are not interchangeable — their designs reflect their specific location in the city, their elevation above sea level, their particular aqueduct and their unique relationship to that aqueduct. This type of information can lead a designer to understand how contemporary fountain design (which is becoming more and more generic) can actually be used to reflect and reinforce the identity of a specific location.

2) By locating each of the fountains, and noting formal and typological differences, such as ornamental fountains, animal troughs, freestanding fountains, laundry fountains, etc., a hierarchy of water uses, a "flow" chart as it were, that reflects social and cultural values began to emerge. The movement of water, and the maintenance of water quality was very carefully orchestrated to flow from drinking fountains, to animal fountains, to laundry and industrial fountains, and then into orchards or into the sewers. There are very clear lessons about water conservation and water distribution that can be drawn from this information and then applied to an understanding of current design issues. The mapping further revealed that each of the fountains types provided important information about the labor resources in the city and the topographies of work, such as the loci of tanning, fullers and water sellers. Of particular interest to me is what I call the landscape of laundry, i.e., how the physical location chosen for laundry fountains impacted how ordinary women used the city as they performed their day-to-day activities. This is the type of data that is essential for revealing the other histories of cities — those of its women, minorities, and workers.

3) According to Congressman Blumenthal of Oregon, 1100 American cities and towns must address the issue of Covered Sewer Overflows that are inadequate to deal with wet weather flooding. Over the next twenty years these CSO's will be uncovered and reworked, and will be incorporated as open water systems in urban parks and recreational areas. This is not simply an issue for sanitary engineers, but also a design issue that has the potential to dramatically and positively impact the form of cities. Portland Oregon alone will spend 3/4 to one billion dollars to recapture riverfront land. It is a tremendous opportunity for architects who can positively address the issues of siting buildings in relationship to active water systems. Anything that we as educators can do that will increase student awareness of dynamic water systems will greatly expand the ability of the profession to deal with these design challenges.

These are merely three examples of how this information can impact architectural design, theory and history. I am relying on you to imagine other uses and to participate in the design of other studies that begin to reveal the hidden hydrological dimensions of cities.