



Project Number ______
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Preserving Venetian Wellheads

An Interactive Qualifying Project Submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the degree of Bachelor of Science

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Lewis Blackwell

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Meghan Fraizer

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Adria Rizzo

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Kevin Vello

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Randall Wainwright

Advised By:

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Professor Fabio Carrera

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Professor Peter Christopher

Abstract

This project serves to aid and promote the preservation of Venetian wellheads by creating resources in the form of a comprehensive public Venetian wellhead catalog. This catalog may be used in building efficient restoration strategies. Through the creation of walking tours, an educational program, web pages, and promotional merchandise, we intend to help increase public awareness of these commonly overlooked pieces of art.

Authorship Page

This report has been written and reviewed equally among our team and it is difficult, if not impossible, to say who specifically wrote each section since the entire project has been one collaborative effort. It is possible though to mention what each of us concentrated on.

- Lewis Blackwell wrote sections of the background, parts of the results, and recommendations.
- Meghan Fraizer worked on recommendations, background information, along with the database, walking tours, and the educational program.
- Adria Rizzo wrote parts of results, introduction, background, recommendations, methodology, along with the walking tours and the educational program.
- Kevin Vello wrote the analysis and results, developed the algorithm, and prioritization list, and helped to organize the database and photographic archive.
- Randall Wainwright wrote the analysis, created diagrams, and wrote many parts in the background, methodology, and results, along with organizing the photographic archive.

This does not mention the fact that we all did extensive fieldwork and edited repeatedly.

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Chapter 1 - Executive Summary

"Water, water everywhere, but not a drop to drink." – Coleridge[1]

Wellheads are the visible portion of the underground cisterns from which Venetians used to draw their drinking water. Often decorated with carvings of flowers, animals, saints, family crests, or inscriptions, these pieces of art are commonly overlooked. It was our goal to increase preservation efforts and promote public awareness for the wellheads. The purpose of this section is to give an overview of all of the aspects of our project.

Through research we learned about the history of the wellheads, their importance in Venice, and their need for restoration. It quickly became apparent that the wellheads are an unknown piece of history to people other than Venetians. Since they stopped being used in the late nineteenth century, they have become simple stone structures lining the streets of Venice.

Our fundamental objective was to create a complete computerized c atalog of all of the remaining public Venetian wellheads. This required extensive amounts of fieldwork so that we could collect all of the necessary information pertaining to each wellhead. Using Alberto Rizzi's *Vere do Pozzi di Venezia*, we were able to determine the location, material composition, and approximate date of construction of each wellhead. With this information, we went into the field and recorded numerous measurements, importance factors, lid information, angles of all sides and corners, and platform information for the wellheads. We also performed a deterioration analysis

[1] Coleridge, Samuel Taylor. The Rime of the Ancient Mariner.

of each side and corner and took note of any figure, carving, inscription, and metal accessory that appeared on the wellhead. Once all this information was collected, we developed a complete catalog that can be accessed by future research teams who wish to find out any information about the wellheads. We found that of the 232 public wellheads cataloged in 1981, 217 of them are still public today, with the other 15 turned private.

Once the database was completed, we were able to analyze the results and determine which wellheads had the highest need of restoration. The analysis incorporated different weights for each type of deterioration into an algorithm that, once com bined with the data, would allow for a complete list of the wellheads in the order they should be restored and preserved. If this list is implemented, the wellheads will be around for generations to come and none of them will fall into obscurity.

To create public awareness about the wellheads we needed to target various groups of people. An educational program was created to supply teachers with ideas of ways to incorporate wellheads into the classroom. Activities and fieldtrip ideas were supplied to ea sily fit the study of wellheads into art, science and history courses for local schools. A walking tour was created focusing solely on wellheads, along with three supplemental tours to the APT series *Venice Beyond Saint Mark's*. The supplemental tours were created in collaboration with Worcester Polytechnic Institute's 2000 External Sculpture Team, and supply information about the wellheads and pieces of public art located along these preexisting tours. Posters, postcards, calendars, and bookmarks were also created as tools for future fundraising groups. Other fundraising ideas were also discussed and recorded for future teams to research.

To promote preservation efforts we created the need-based list as aforementioned. We also researched various cleaning techniques and preservation methods and determined their feasibility concerning the wellheads. Other ideas were centered on having the wellheads serve a purpose once again. Since one of the only portions of a wellhead that can be changed is the lid, all of these ideas involve replacing the lid, which is needed on a

majority of the wellheads anyway, due to rust creating holes in the lid, leading to safety hazards and damages done to the wellheads. We developed ideas for the replacement lids, which inc lude tourist directories, flower containers, and sundials. These new lids would present a need for up keeping which would allow the wellheads to no longer be neglected and instead be preserved on a regular basis.

In conclusion, through an increase in pub lic awareness and restoration efforts, the wellheads will no longer be viewed as benches or trashcans, and will instead be recognized for the pieces of public art that they are.

Chapter 2 - Introduction

Venice is a city overflowing with artifacts. Public art pieces line even the smallest alleys, while gondolas float through the canals. Through the development of this city, several innovations were implemented to allow life to exist on such a small group of islands in a lagoon. One of the main problems was the lack of a fresh water source from which to drink. This problem was solved with the creation of underground cisterns located in *campi*, or squares throughout the city, which would collect rainwater through drains in the ground, filter it through fine river sand, and store it in a clay tank. Venetians were then able to access the water in the wells on a daily basis.

These cisterns were located all over the city, and were capped with a wellhead. Primarily made of stone, these wellheads were decorated with carvings, inscriptions, and were a meeting point for the citizens for centuries. The cisterns are no longer in use, as the incorporation of an aqueduct stemming from the mainland has made them obsolete. However, the wellheads still stand as an ever-present reminder of the past lives of thousands of Venetians.

The purpose of this project was to create a complete computerized catalog of all of the remaining public wellheads in Venice. Two EARTHWATCH teams and a WPI project team had preformed previous fieldwork. However, we felt that it was necessary to catalog all public wellheads in the six *sestieri* of Venice and the Giudecca to ensure consistency throughout our results and have updated information. Had we simply finished the catalog using the previously collected information, we would have only needed to perform fieldwork in the three *sestieri* of San Marco, San Polo, and Santa Croce.

As a basis for our data collection process, we referred to *Vere da Pozzo di Venezia*, by Alberto Rizzi. From this catalog, we took information pertaining to each wellhead such as location, material, and period during which the wellhead was constructed. We also performed an analysis of state of conservation of the sides and corners of the wellhead. Combining the information from *Vere da Pozzo di Venezia* with our deterioration assessments we then created a catalog that will serve as a reference for future research teams. The catalog of public wellheads we constructed includes records of dimensions, material construction, lid shape and material, deterioration ratings for all sides and corners, importance factors, special features, location, and identification numbers. Our team members assigned all of the assessments of the state of conservation of deterioration of each of the well heads during extensive fieldwork. This catalog will prove to be useful for restoration and preservation processes, as it can be used to search and find wellheads most in need of cleaning and restoration.

Our main goals were to propose ideas on how to increase public awareness and promote restoration efforts for the wellheads. To increase public awareness, we created several walking tours that highlight some of the more artistic and historic wellheads throughout the city and provide the reader with information about each wellhead along the way. In association with another Worcester Polytechnic Institute project team whose focus was external sculpture, we created supplemental walking tours to coincide with the tour series *Venice Beyond Saint Mark's,* created by the Azienda di Promozione Turistica.

These supplements highlight wellheads and public art pieces, which exist along the paths of each tour. Our teams also created a tour for the disabled. Making these tours available for the public could potentially increase awareness about commonly overlooked pieces of art in Venice.

Our teams also developed an educational program to aid teachers in promoting public art awareness in Venetian students. This program is geared toward young adolescents in hopes to encour age respect for all public art. To target other demographics, we created a web site in order to reach the global community through use of the Internet.

Performing an analysis on the information we collected allowed us to determine the wellheads most in nee d of restoration, cleaning, and preservation (See Appendix J). This information should be made available to the appropriate organizations to ensure that suitable measures are taken to guarantee that the wellheads are preserved instead of allowing them to become irreversibly damaged.

We also made recommendations about possible fundraising ideas for the wellheads including, but not limited to the creation of postcards and a calendar. We believe our work will help ensure that wellheads are preserved so as to not lose a valuable part of Venetian history.

Chapter 3 - Background and Literature Review

In order to understand the nature and scope of this project, one must know and appreciate what a wellhead is. It did not take long for our project team to realize the lack of relevant data on the subject of Venetian wellheads as gauged merely by trying to give others an adequate project description. By endeavoring to promote the preservation of Venetian wellheads, we must deal with a lack of general knowledge of the subject. To begin with, a wellhead or *vera da pozzo* in Italian, is the top of a well and in Venice they are works of art, even if they are not always treated as such.

3.1 History of the Wellheads

Venice is located in the middle of a salt-water lagoon fed from the Adriatic Sea. The lagoon offered protection from invading hordes of Lombards due to the undesirability and difficulty of navigation, but cut off Venice from reliable sources of fresh water. Eventually, Venetians built underground structures to collect and even filter rainwater into a form that was healthier than its initial state, and more permanent and safer than open-air containers.

The wellheads serve many useful and decorative purposes, some more obvious than others. Typically, they were built out of stone, which still stand today, as opposed to the wells that were made quickly out of brick for necessity, rather than aesthetics. [2] As a result, the wellheads functioned as protection for the water source by preventing animals from falling in, or floodwaters from contaminating the drinking water. It was common to have a small hollowed-out "bowl-like" structure near the base of the wellhead, which would be kept full for animals to drink, and several of these still serve this purpose today.

As time passed, the city grew and so did the number of wellheads. They were typically located in the center of a *campo*[3]. They were always at the center of socialization and interactivity among Venetians. From photographs dating as

Figure 3-1 Activities Around a Wellhead

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[2] The Well-Heads of Venice. Alberto Rizzi, La Stamperia Di Venezia Editrice. p. 8

[3] Public courtyards; not to be confused with the *corte*, which were closed public courtyards with one entrance, nor the *cortile* which refers to a private courtyard hidden within a patrician town house

late as the nineteenth century, women washed clothes on the steps of the wellhead platforms, children played nearby, and men hauled up and carried water from its interior. [4] See Figure 3-1 for an illustration of a typical gathering around a wellhead located in the Doge's Palace. [5]

Wellheads exemplified the city's culture, and love for art. While many other civilizations were using aqueducts, artesian wells, and aboveground water col lection methods, the Venetians depended on cisterns for their water supply.

3.2 Public versus Private Wellheads

The difference between a public and a private wellhead is defined by ownership and use. Private wellheads are those that were built by a resident o r organization prosperous enough to afford the excavation and construction of their own wellhead. In this way, that person or persons could have exclusive access to their own water supply if they so desired, as well as enjoy the convenience of close proximity. Public wellheads were primarily built by the government for use by the public, and belonged to the city. The responsibility of maintenance was also defined by ownership to the effect that private owners had to care for their own wells. This had a drastic affect on the difference in artistic freedom and level of maintenance between public and private wellheads. The focus for designing public wellheads tended to be utilitarian to a higher degree than what was necessary for private owners.

Aside from the care taken in maintaining the state of conservation, which is visibly higher for private wellheads, deteriorating factors such as weathering, everyday use and vandalism were more prevalent in the environments of public wellheads. Private wellheads had the benefit of the protection offered by a locked gate, whereas the public wellheads suffered from the overuse associated with being public.

3.3 Water Supply

During the eighth century, as Venice was beginning to develop into a city, it did not have many options for obtaining drinkable water. Fresh water used by civilizations throughout history can be classified into four primary categories. These include rainwater, ground water, aboveground water, and second-hand sources. Rainwater is primarily dependent on the path and pattern of weather systems and climate of a particular area. Ground water is obtained by drilling deep enough to reach the water table, or the artesian aquifer, where rainwater filters down and collects in the earth's crust. Aboveground w ater occurs when water collects on the earth's surface (i.e. rivers, freshwater lakes). A second -hand source is the transportation of water by open -air or pipeline aqueduct, usually from a maintained aboveground source such as a reservoir, lake, or an art ificially processed freshwater source.

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[4] Knopf Guide: Venice, Italy . Alfred A. Knopf, Inc., New York. 1993. pp 1 -7

[5] Ibid. p. 3

3.3.1 Artesian Wells

The artesian well functions on the concept of digging deep enough to reach the artesian aquifer, which exists below the water table. For early Venetians, this particular type of water collection was implausible since there was no way of knowing that an artesian aquifer existed until the nineteenth century. Even if they had the information, it would have been useless due to a lack of adequate drilling equipment. Water enters the aquifer from an area on the Earth's surface, filters through the aquifer and escapes through springs and wells located at a lower point as shown in Figure 3-2.[6]

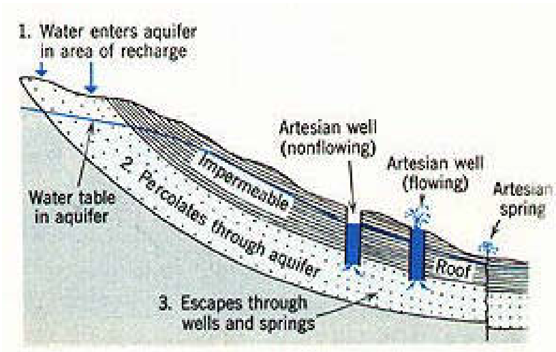

Figure 3-2 Cross-Section of Artesian Wells

There is an artesian aquifer that exists below Venice and the mainland, thereby making it accessible from both locations. This type of well was used in Venice starting in the late 1800's but it was discouraged and eventually stopp ed due to the risk of accelerating the sinking of the city by decreasing the pressure in the aquifer[7]. In 1975, all artesian wells on the mainland were closed, about nine years after the record-breaking 1.94 meter -high tidal flood was recorded by the mare ograph at Punta della Salute which had begun rumors that Venice might disappear.[8]

3.3.2 Aqueducts

Towns and cities usually develop in areas where water is plentiful. Such cities may develop around lakes and rivers, or build wells to draw on underground sources. As cities develop and expand, the source of water sometimes becomes insufficient or too contaminated for domestic use. In cases such as these, aqueducts may be implemented to carry water from beyond the exhausted local site. For most of Venice's histor y, the massive construction involved in building an aqueduct from the mainland to the islands of the city was impractical and only barely feasible.

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[6] Artesian Wells. HTML Format: Maintained by David Hergott. Personal Webpage. Last cited Tuesday, May 2nd, 2000. Available from http://gilligan.esu7.k12.ne.us/~lweb/Lakeview/science/art.htm

[7] The Well-Heads of Venice. Alberto Rizzi, La Stamperia Di Venezia Editrice. p. 19

[8] Michelin Tourist Guide: Venice. Michelin et Cie, Propriétaires-Éditeurs, 1998. p. 30

Aqueducts may be canals, open troughs, overland pipelines, or tunnels. The earliest aqueducts were dug through clay or cut out of solid rock. Engineers in the past used wood, stone, and concrete to build the main part of the structure, a few even using siphons to carry water across valleys and over hills. In general, aqueducts had to follow gentle, downhill courses, at times taking paths around mountains, through hills, and atop long bridge-like structures. Figure 3-3 is a picture of the Pont du Gard aqueduct located in Nîmes, France [9]. Modern aqueducts function through use of pressurized construction and pumps to circumvent the necessity for gravity to transport water. [10]

Figure 3-3 Example of an Aqueduct

At the beginning of the nineteenth century, there were approximately 30,000 people sharing the use of roughly 300 public wells. [11] Since 1884, Venice's supply of water has been from an aqueduct connected to the mainland. When the aqueduct was brought to Venice the wellheads were sealed and 120 given spouts and used to store water. Now many spouts are left, but only a few still supply a constant flow of drinkable water.[12]

3.3.3 Historical Venetian Water Supply

The main available source of fresh water for Venetians was rain, so they needed to devise and implement a method to collect and filter the rainwater, as it was imperative for the survival of the city. The most effective and reliable way to obtain drinkable water was to build permanent structures, or cisterns, which imitated the process of collecting ground water only on a smaller scale. To keep these wells in working condition, an efficient maintenance system was needed.

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[9] This aqueduct was built by the Romans in 19 BC and stands about 160 feet high according to Compton's Online Encyclopedia. HTML Format. Aqueduct. [Online Article] Cited Friday, July 14, 2000. Available from http://www.comptons.com

[10] Compton's Online Encyclopedia. HTML Format. Aqueduct. [Online Article] Cited Wednesday, May 03, 2000. Available from http://www.optonline.com/comptons/ceo/00250_A.html

[11] Rizzi, Alberto. The Well-Heads of Venice. Stamperia di Venezia Editrice, Venezia 1981. p 19

[12] Ibid.

3.3.4 Maintaining the Venetian Water Source

The maintenance of Venetian wells was of the utmost importance because they were the primary source of drinking water for all citizens of Venice[13]. Wells were monitored by guilds, working in conjunction with the district officials. The district officials opened the wells twice a day at the sound of a bell, while porters at different locations on the lagoon were responsible for cleaning the wells and the wellheads. Money for the construction of new wells and well maintenance was obtained from contracting the fare-charging ferry services on the Grand Canal.

In times of exceptionally long droughts, it was not unheard of to have a boat travel to the mainland and acquire water from a freshwater source. In fact, the Venetians built a special canal on the mainland called the *Seriola* used to store water in preparation for such circumstances.

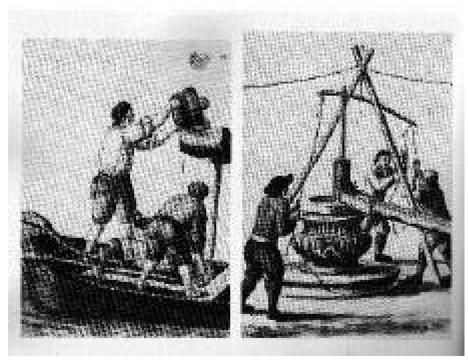

Figure 3-4 Acquaroli Filling a Well

Two of the many guilds connected with the wells were called the *Pozzeri* and the *Acquaroli*. The *Pozzeri* was a small group of citizens who were a part of the guild of stonemasons. They were responsible for constructing the walls of the well shaft and the floor of the water-gathering basin.

Since water was considered a most precious commodity, the access to it was limited in many ways. The *Acquaroli*, seen in Figure 3-4, were responsible for supplying water during periods of drought. They were also responsible for making sure that the water from public wells was not used for commercial use such as by barbers, dyers, and painters. The public wells were guarded to make sure that Jews, who were restricted to only using the wells in the ghetto until 1703, did not use them. The *Acquaroli* also ensured that water, which was to be used exclusively for the poor was not sold on the streets.

[13] Ibid. pp 11, 18

3.3.5 Venetian Cisterns

Each wellhead is the cap to a well 5-6 meters (16-20 feet) deep. The well is composed of a brick or stonewall surrounded by fine river sand.[14] See Figure 3-5[15] for a diagram of a typical cistern. The sand surrounding the well acts as a filter for the water that permeates down through grillwork at the street level, usually located in a campo, to eventually collect in the well. In order to keep the water from seeping irretrievably deep into the ground, a layer of clay lines the bottom of the entire bowl -like structure, separating it from the surrounding mud, and possible underground salt -water contamination.

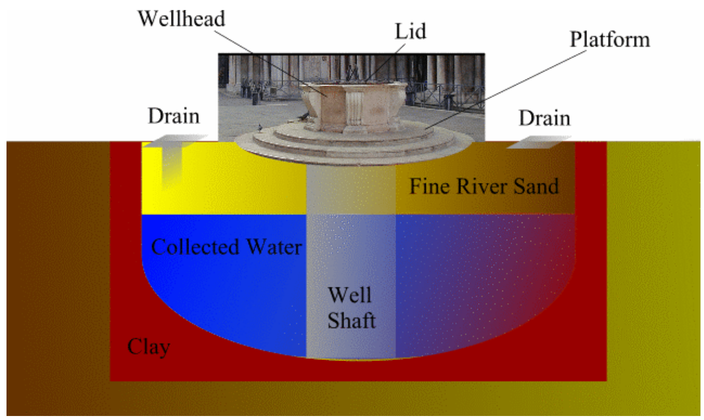

Figure 3-5 Cross-Section of a Cistern

Construction consisted of first excavating the area, then driving a temporary wooden dam into the ground. This was done to hold the mud back so that work could proceed simultaneously on the central shaft while surrounding it with sand.[16] Figure 3-6 shows an overhead view of a typical wellhead construction site. Notice that the drains are laid before the shaft is completed. Although the wellheads are no longer used to collect drinking water, the cisterns re main below most of the campi as well as many of the original drains. The cisterns are permanent structures and usually remain even after the wellhead has been removed.

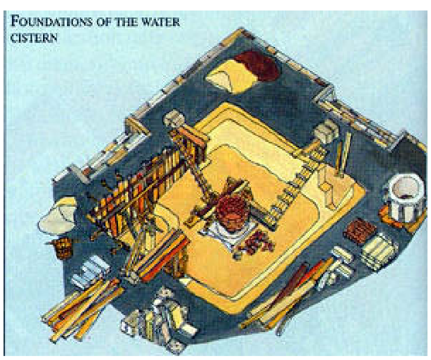

Figure 3-6 Construction of a Cistern

3.3.5.1 Advantages of Cisterns

Besides the fact that other options were not readily available t o Venice for obtaining fresh water, there were benefits to gathering and filtering rainwater over other traditional freshwater sources. In particular, Venice benefited from strategic implications, the advantage of controlling the spread of contaminants, and the emphasis on small community interaction.

[14] Michelin Tourist Guide: Venice. Michelin et Cie, Propriétaires-Éditeurs, 1998. p. 50

[15] All figures not cited herein were created by ou r project team.

[16] Knopf Guide: Venice, Italy. Alfred A. Knopf, Inc., New York. 1993. p. 80

In times of siege, which were many in the course of Venetian history, Venetians had a protected water source independent of the outside world. The water in the wells could be stored for extended periods of time since the Venetian cisterns functioned as closed containers. Intentional contamination by outside sources was nearly impossible due to the natural defense of the difficult-to-navigate lagoon, and internal contamination was minimized by strict government regulations.

Any contamination that may have occurred was restricted to individual wells since each well was logistically part of a greater water-distribution network, but still physically separate. In an artesian well system, the wells are linked to each other since all water is drawn from the same source, the artesian aquifer, and therefore, the entire water supply is subject to substances that can propagate through fluids such as poisons and heavy metal contamination. Such is not the case with cisterns, as each cistern acts as an individual container to hold water.

Physical proximity is not synchronous to social closeness, but rather the sharing of common goals in an interactive environment. In essence, the wellheads provided a place for people to share in the common mundane goal of collecting water. However, it was not just the fact that people lived together that created close-knit communities, but the chores that could be performed together safely within the confines of a nearby *campo*. The wellheads and surrounding *campi* were places where people not only gathered to obtain water, but to socialize and emotionally bond with others.

"The *campo*, sometimes dotted with a few trees, is encircled by fine patrician houses, Gothic or Renaissance in style and blessed with its own church. At its center, a well might occupy a choice spot…a square provides a point at which all roads, streets and alleys converge: it is at the very heart of community life where housewives chat and hang out their washing, where children play in the open."[17]

Today, people still gather around a few of the wellheads, but not to wash clothes or to draw water. For the most part, people gather around the wellheads because a few have realized it is practically the only thing to sit on in sight. Tourists and residents alike sit on the steps of the platform, and lean up against smoothed surfaces made partially by the weathering of time and artisans long-since forgotten. People sit on the smoother lids and inadvertently kick the stone surfaces, which will eventually lead to an accelerated rate of deterioration of the stone surface.

Weighing the social impact of the wellheads is difficult to gauge today, as it seems mutually exclusive of preservation. Even when the wellheads were in use, they suffered damage from everyday wear and tear including deep indentations where years of pulling water up by rope rubbed away the stone.

Does the value of the wellhead as a bench surpass its value as art? It sounds like an easy question to answer, at least if one has not spent time in Venice. Attempting to dissuade people from sitting down in a city in which walking is the primary means of travel might even be considered cruel. When all is said and done, it is inevitably the choice of Venice, the Venetians, of where and upon what they wish to allow people to sit.

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[17] Michelin Tourist Guide: Venice. Michelin et Cie, Propriétaires-Éditeurs, 1998. p 48

3.3.5.2 Drawbacks of Using Cisterns

Along with the benefit of storing water for long periods, there came drawbacks stemming from the environment as well as problems associated with their design. These problems include stagnant water, saltwater contamination, dependence on rainwater, and health concerns.

Unlike large bodies of water, or flowing water, contaminants lingered indefinitely in the small shafts of the Venetian cisterns. The effects of certain biological pollutants were amplified by the fact that the wells were relatively stagnant water and if, for example, a rat fell in, the bacterial infection could proliferate relatively unhindered. The bubonic plague was one such disease that propagated in this way.

The greatest and most real threat to the water source of Venice was the sea, specifically from the risk of tidal flooding. When rising tides combine with storm winds, the level of the sea can rise along the coast. For Venice, located at sea level, the effects were often devastating (See Section 3.6.4.1). Tidal flooding was a risk to all the wells simultaneously, contaminating the fresh water with undrinkable salt water. Rectifying the problem was a long and difficult task and involved emptying the well into the canals after the flood had subsided and either waiting for it to fill up again or refilling it manually with water from the mainland. Early on, certain *scuole*[18] were in charge of assigning people to watch over the wells and take on the responsibility of closing off the wellheads and sealing the drains with wax.

Another drawback of a water source dependent on rainwater was the unpredictability. In excessively long periods without rain, the limited volume of the wells could be exhausted. In times like these, water had to be brought to Venice from an outside source and there were strict limitations placed on water consumption.

Rainwater is not very sanitary due to the way that rain droplets form around particles floating in the air. Although sand works relatively well as a filter for larger particles, such a system cannot filter out substances that dissolve in water. Water can be made safe to drink by adding progressively smaller filters. In addition, there are no colloidal or trace minerals in rainwater, and therefore rainwater has a significantly lower mineral value than water drawn from run-off fed sources.

3.4 Wellhead Styles

The wellheads are cylindrical, occasionally with distinct sides decorated with carvings, small arches, or other architectural structures. Some of the wellheads are set high enough above ground level to require steps leading up to the brim of the well. This was done mainly to prevent salt-water contamination associated with tidal flooding.

Arches were occasionally implemented in the design of the wellheads early on, but by adding too many decorations, the design could interfere with its function, which may be what kept the wellheads at a level of complexity lower than other art of the period. As the city prospered and the outward appearance of everything else became more elaborate, the wellheads soon followed in extravagance. The carvings on

[18] A corporation or a guild; designates a form of association between lay citizens

the sides of private wells usually reflected the owner through various depictions of family crests or inscriptions. Conversely, public wells were typically decorated with symbolic and often functional carvings of saints usually facing the nearest church, or symbols depicting public use. Many public wellheads once bore a carved image of Saint Mark's lion. Unfortunately, toward the end of the Republic, over 1000 lions were removed, leaving behind empty panels and making most of the wells nearly featureless.[19]

The decorative characteristics of wellheads mainly ranged through the Carolingian, Byzantine, Gothic, Renaissance, and Baroque eras.

3.4.1 Carolingian

The Carolingian style after the Frankish king Charlemagne, derives mainly from Roman traditions[20]. This archaic style from the 8th and 9th century is usually composed of simple arches and other geometric features symmetrically oriented, as can be seen in Figure 3-7.

Figure 3-7 Carolingian Style Wellhead

3.4.2 Byzantine

The Byzantine era ranging from the 10th through 13th centuries was distinct in two ways. Firstly, this art style was based on Christianity. There was no longer the portrayal of many gods, but instead the theme was on one god, one faith, and one tradition. These became the standards for Byzantine art. Secondly, the Byzantine style is usually flat, with an emphasis on elaborate design instead of naturalistic depiction.[21] Art all over Venice reflects this style due to the Venetian Republic's close contact with the Byzantine Empire throughout its history.

Figure 3-8 Byzantine Style Wellhead

[19] Rizzi, Alberto. The Well-Heads of Venice. Stamperia di Venezia Editrice, Venezia 1981. p. 32

[20] Gilbert, Rita. Living with Art. McGraw-Hill, New York 1992 pp 398, 399

[21] Ibid.

3.4.3 Gothic

Figure 3-9 Gothic Style Wellhead

In time, the people of Venice prospered and dedicated more time to beautifying the city as a whole, including such commonplace objects as the tops of wells. Since most of the wellheads were privately owned and decorated, there was a need to bring the public wellheads to similar standards, considering the city's history of extravagance. The Gothic style dominated Venetian art from the 13th to mid-15th centuries and was characterized by a very pointed and intricate design in its arches and on each side.

3.4.4 Renaissance

The Renaissance style was used primarily from the 14th to the 16th century. This style originated in Italy and was characterized by a renewed interest in classical art, specifically, classical Greek and Roman cultures. In the Renaissance style, features take on a more naturalistic form to simulate reality, as seen in Figure 3-10. At each corner, the sculptor has put a lot of effort into making the leaves and other plant forms as realistic as possible. The flower between the corners has a geometric appearance which could suggest the artist incorporated several styles.

Figure 3-10 Renaissance Style

3.4.5 Baroque

The 17th century marked the decline of the Venetian Republic and by the 18th century, the wellheads all but faded into the obscurity of apathy in the face of greater issues. Regarding its attention to art and architecture, the Baroque period was a slight twist on the Renaissance as a style characterized by a new simplicity. With a sprinkling of decoration and use of carvings to accent the edges of lines, mixed with a use of heavy spaces, gave a feeling of solidarity in tradition of the Gothic style.

Figure 3-11 Baroque Style Wellhead

3.5 Material Composition of Wellheads

The public wellheads in Venice are made primarily from Istria Stone or Verona Marble. Private wellheads and modern re-creations have a greater variety of materials than those of the original public wellheads, but in this section we are focusing on the materials that will become most relevant in fieldwork and analysis including the rare Aurisina.

3.5.1 Istria Stone

Istria Stone is a type of limestone and has a gray-green to yellow color. Long exposure to the atmosphere causes it to obtain a whitish appearance, through a process called "white washing." It is a prime candidate for exfoliation. (See Figure 3-12)

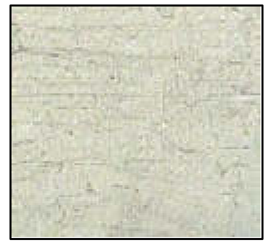

Figure 3-12 - Istria Stone

3.5.2 Verona Stone

Verona Stone, often called Verona Marble, is not actually marble, but a sedimentary rock. It is composed of organic limestone and fossils.[22] It has either a reddish or whitish color depending on the organisms it contains. Red Verona is easily distinguishable from Istria due to the hue. White Verona is distinguishable from Istria because White Verona has a more heterogeneous appearance, and has small patches of slightly different colors located throughout the stone (See Figure 3-13).

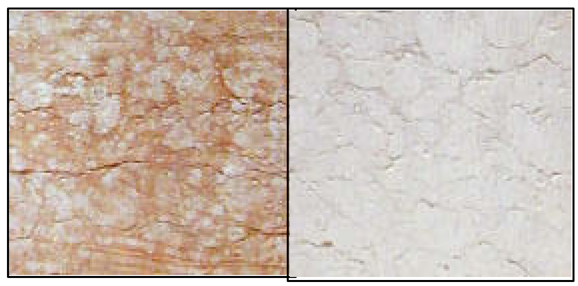

Figure 3-13 - Red and White Verona Marble

3.5.3 Aurisina

Aurisina stone is an organogenous limestone usually having a grayish color and granular appearance (See Figure 3-14). Aurisina is usually found in Venetian sculpture dating between the 8th and 10th century. Around the end of the thirteenth century, it was no longer used as a material for sculpture, but instead made obsolete by durable Istria stone[23].

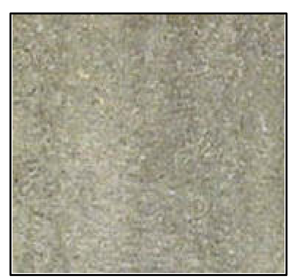

Figure 3-14 - Aurisina Stone

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[22] Amoroso, Giovanni. Fassina, Vasco. Stone Decay and Conservation. Elsevier, New York 1983 p. 230

[23] Rizzi, Alberto. The Well-heads of Venice. Stamperia di Venezia Editrice, Venezia 1981 p. 377

3.5.4 Wellhead Covers

The lids opened to allow people to access the wells, but when the aqueduct was built in the late nineteenth century, the wellheads were sealed with permanent, sturdy lids for safety reasons.

Some were made of wood, but wood tends to decay rather quickly, which encouraged the city to implement metal lids. These proved to be longer lasting than wood; however, even metal decays by corrosion and has the unfortunate side effect of staining the stone surfaces from rain run-off accumulation.

A few of the wellheads have metal covers that have oxidized to the point of structural instability with holes large enough to put a small hand through. Aside from the obvious threat of Tetanus to curious children, the holes are also large enough to drop refuse through, which one can imagine would be reasonably difficult to remove without damage to the wellhead.

3.6 Imminent Dangers to the Wellheads

The wellheads are typically located in the middle of large, open areas, which exposes them to many different threats. Vandalism, inappropriate human contact, air pollution and water damage may all pose threats to wellheads on a daily basis.

3.6.1 Unintentional Damage

Since the wellheads are located at a level in which people can easily interact with them, many wellheads are used by Venetians and tourists as meeting places or benches over looking their artistic and historic significance. Although the platforms of the wellheads can tolerate constant human interaction, sitting on the lid can cause many problems. (See Figure 3-15) Sitting on the lid adds extra weight onto the wellhead that it is not designed to hold. Kicking feet against the side of the wellhead can cause the stone to flake or break off more rapidly than under normal conditions. This everyday interaction with the stone materials places them in a more urgent need of restoration.

Figure 3-15- Unintentional Damage

3.6.2 Vandalism

Vandalism poses a large threat to the state of the wellheads. Many wellheads show graffiti created by disrespectful individuals. These unwanted markings, although causing no actual damage to the stone, greatly take away from the beauty of the wellhead and are difficult to remove. Education on how the wellheads are important pieces of art and history may help prevent future defacement from occurring.

3.6.3 Pollution

Air pollution in particular is a major cause of damage to many types of stone. Harmful gasses, which are the underlying components of air pollutants such as carbon dioxide, can eat away at the stone surface.[24]

In the twentieth century, the outboard motor became prominent in Venice and with it came the problems associated with organic fuel-driven engines, in this case, gasoline. A rising threat to all outdoor stone surfaces is acid rain, or acid deposition. The term was coined by a Scottish chemist by the name of Robert Angus Smith, in his 1872 book, *Air and Rain: The Beginnings of Chemical Climatology*.[25] To summarize the definition provided by the Environmental Literacy Council:

"Rain is naturally acidic, because carbon dioxide in the air dissolves in oxygen to form a weak carbonic acid. An acid is any chemical that releases hydrogen ions when dissolved in water. The higher the concentration of hydrogen ions, the more acidic a solution is. Rain that is mixed with sulfur and nitrogen in the air becomes more acidic than normal. Sulfur dioxides come from natural and human sources. Natural sources include volcanoes, forest fires, and biological decay, but the primary sources of sulfur dioxide and nitrogen oxide from human activities are power plants, factories, and automobiles." [26]

On its own, air pollution is usually dispersed enough to not cause damage to the surfaces of the wellheads through direct contact. However, when pollution from the industrial zone on the mainland and gasoline-powered boat motors combines with moisture in the atmosphere, the acidic mixture can seep its way into the crevices in stone and accelerate deterioration.

3.6.4 Water Damage

Water is involved in many deterioration processes and many materials will not corrode without the presence of water.[27] Building materials along with external artwork in Venice have a high corrosion rate due to the effects of rainwater, floods and sea air.

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[24] Amoroso, Giovanni. Fassina, Vasco. Stone Decay and Conservation. Elsevier, New York 1983 p. 54

[25] Environmental Literacy Council. HTML Format. Acid Rain. [On-Line Article] Cited Monday, May 1st 2000. Available from: http://www.enviroliteracy.org.

[26] Environmental Literacy Council. HTML Format. Acid Rain. [On-Line Article] Cited Monday, May 1st 2000. Available from: http://www.enviroliteracy.org/acid_rain.html.

[27] Amoroso, Giovanni. Fassina, Vasco. Stone Decay and Conservation. Elsevier, New York 1983 p. 13

One form of water damage results when water seeps into a material from rain, flooding, or just from the moisture in the air. After the water has made its way into the material, it will either evaporate or freeze. When evaporation occurs, the material will tend to shrink which can cause cracking.[28] Freeze-thaw deterioration occurs when the water seeps into existing cracks or pores in the stone, first freezes causing the stone to expand, and then thaws, which makes the stone contract. This process is often referred to as "frost-wedging." See Figure 3-16 for a diagram of the process. The freeze-thaw cycle can

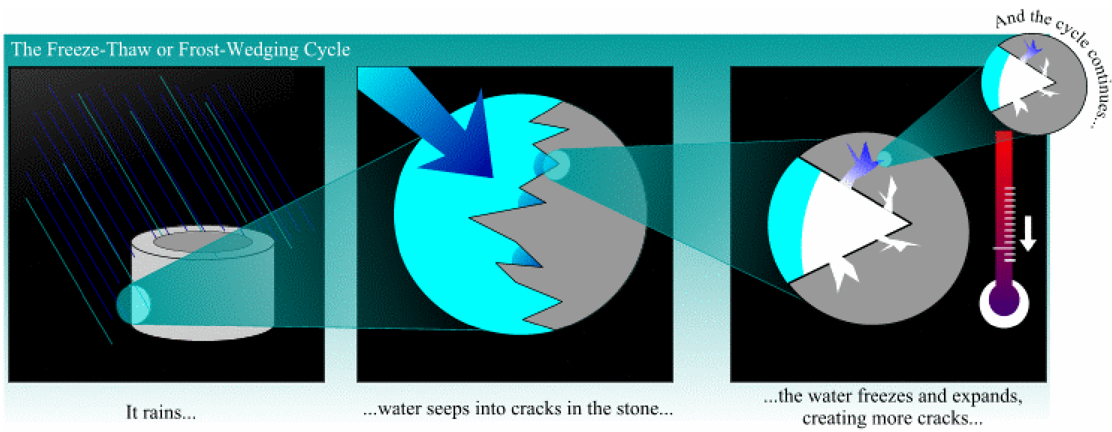

Figure 3-16 - Diagram of Frost Wedging

generate cracking in any type of material, but has a notably more catastrophic affect on stone due to its lack of elasticity. Each consecutive cycle makes the damage exponentially worse since more water can get deeper into the stone and cause expansion. The damage would be less in places where it stays cold all winter, and does not vary between freezing and non-freezing temperatures.

3.6.4.1 "Acque Alte" – (Tidal Flooding)

Originally, the threat of tidal flooding was a danger to the water supply of Venice, but now that the wellheads are no longer a source of freshwater, the threat has been eliminated. Even so, the rising tides still create problems when the preservation of the wellheads is taken into account.

"Each year, between October and April, Venice is flooded afresh by 'acque alte.' These are exceptionally high tides that pour through the three entrances to the Lagoon and inundate the city. They result from a combination of natural phenomena: high tide, a variation of the atmospheric pressure, and rising winds. None of these would have serious consequences if they occurred separately, but since Venice is sinking anyway, when these elements unite they can create tides of three feet roughly once every twenty years, and of five feet about every two hundred years…[the next catastrophic *acque alte* predicted in the year 2030AD]"[29]

[28] Ibid. p. 23

[29] Knopf Guide: Venice, Italy. Alfred A. Knopf, Inc., New York. 1993. pp 26-27

The results of water damage from frost wedging and salt -water erosion are accelerating the destruction of any and all stone surfaces within the three-foot reach of the acque alte, which includes many of the ground-level wellheads.

3.6.5 Biological Threats

Biodeterioration is defined as the unwanted change in materials due to living organisms, along with other factors such as weather. The research that exists on biodeterioration has focused primarily on small, plant organisms such as bacteria, algae, fungi and lichens. [30]

The effects of bacteria on stone surfaces are still being researched; however, bacteria are more prevalent on weathered surfaces than those that are protected from the harsh conditions. It is difficult to determine if the bacteria are the primary cause of the stone decay or if the decay is because the weathered condition of the stone is an inviting place for bacteria l growth. The only clear piece of information found about bacteria is the fact that it causes discoloration on stone surfaces. [31]

"Stone deterioration due to fungi largely depends on the production of corrosive metabolites that can solubilize minerals."[32] What this means is that the fungus produces an acid, which dissolves the surface of the stone.

Lichen are composed of two organisms, fungi and algae. The fungi provide an attachment site, protection, water and minerals, while the algae provide food throu gh photosynthesis. The contribution of lichens in stone degradation is fairly well established. They cause chemical damage through the production of biogenic acids and physical damage through the penetration of their rhizine/hyphae into stone fissures. [33]

3.7 Historic Preservation

The importance of preserving public art is slowly gaining the public's attention. In order to preserve the history of the city, the people must be made more aware of the positive actions that may be taken by the public and governmen t. Information pertaining to the importance of preservation needs to be available to both parties. Laws and regulations limit the extent of government involvement with the preservation of cultural items, such as the wellheads of Venice. These factors al low for the deterioration of many cultural treasures.

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[30] Biodeterioration of Stone: What Do We Know? . HTML Format. Deterioration. [On -Line Article] Cited Wednesday, May 3, 2000. Available from: http://www.ncptt.nps.gov/notes/22/2.stm.

[31] Ibid.

[32] Ibid.

[33] Lichen. HTML Format. Lichens. [On -Line Article] Cited Wednesday, May 3, 2000. Available from: http://www.mos.org/sln/sem/lichen.html.

3.7.1 Restoration and Conservation

The continuous struggle to protect works of art from damage is dependent on two approaches, conservation and restoration. Conservation involves preserving works of art in their present condition and preventing further damage. This may involve relocating individual pieces to a museum or other safe locations where deterioration factors are kept to a minimum.

Restoration, in the context of art, is the process of repairing a work of art to its former condition. This is usually a delicate process, for it requires the aesthetic knowledge and the ability to replicate the craftsmanship of the original artist. Restoration is usually more controversial than conservation, for it centers on questions such as, how much restoration work should be done, what kind of work and who decides.[34] These are important questions because the success of restoring a work of art is dependant on the answers. Questions and debate are more likely to occur when nobody knows exactly what a piece of art looked like in its original state and at times the restoration may be left to the creativity, experience and ingenuity of the restorer. Inadequate restorations however can ruin a work of art and make it difficult, if not impossible, for future restorers to return it to its original condition.

3.7.2 Extent of Government Involvement

Governments are limited to what they can do when forming policies. As outlined in *Preserving The Built Heritage: Tools For Implementation*, there are essentially "...five and only five things that governments can do…to implement their urban design policies." They are as follows in order of extent of government involvement in the intervention:[35]

- *Ownership and Operation* – Through direct action associated with the responsibility of exclusive ownership and rights to operation.
- *Regulation* – Use of legislation or enforcement of existing legislation to bring about the desired effect by guiding the actions of the individuals or institutions directly involved.
- *Incentives (and Disincentives)* – Offering positive or negative reinforcement to encourage the actions of the individuals of institutions directly involved.
- *Establishment, allocation, and enforcement of property rights* – Empower the individuals, or institution, to rights that allow the ability to act on their own.
- *Information* – The collection and distribution of information that may have influence on the preservation operation.

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[34] Gilbert, Rita. Living With Art McGraw-Hill, New York

[35] Schuster, J. Mark. Preserving The Built Heritage: Tools for Implementation. University Press of New England. Hanover and London. 1997. pp 5, 112-120

When pushing for the preservation of public art, these concepts are crucial to constructing an effective strategy, as they are the only tools that a government may have at its disposal. The requests that do not fall under the influence of one of the five tools will most likely be disregarded as "somebody else's" problem. This goes for any government, including that of Venice.

3.7.3 Current Cleaning and Preservation Techniques

Appropriate cleaning techniques can extend the life of the stone by removing unwanted matter that might eat away at the surface.

The average cost for the repair of one wellhead is between 12 and 20 million lire, which currently is about 6 to 10 thousand US dollars. Replacing a lid is often a priority due to safety and costs approximately 2 million lire (1000 US dollars). [36] Labor costs are the expensive part, as opposed to the material. The job of restoring wellheads is delegated to the lowest bidder by the Venetian authorities. This means the quality may not always be the best, but more wellheads can be repaired.

Cleaning is a very important and delicate process. Extreme precautions must be taken when cleaning, because the process could actually cause more damage if done incorrectly. There are five basic methods currently used in cleaning monuments, outdoor art, and sculpture. Each method has certain benefits and drawbacks and some are more suited to specific applications than others are. They are discussed here in order of feasibility for wellheads.

3.7.3.1 Chemical Cleaning

Cleaning with chemicals, such as acids, removes dirt thoroughly, but can have serious drawbacks. Acid cleaning can be very dangerous and cause irreversible damage. The acid must be completely removed, or it will continue to eat at the stone. Some acids also react violently with water and release toxic fumes, which would be particularly hard to contain.

The most common and current method for cleaning wellheads is as follows as described by the 1997 EARTHWATCH field report: "The cleaning involves making poultices with paper cloth and special solutions (based on standard solution called AB-57) or disinfectant solutions. AB-57 is a government-approved mixture of Ammonium Carbonate, EDTA and Disinfectant in distilled and demineralized water. (60 g, 30 g, and 100 ml, respectively per 1 liter of distilled water). The disinfectant used was 'Amuchina.' The poultices of AB-57 were applied and covered with plastic film (to maintain moisture) and left on for about one half-hour. The disinfectant patched were composed of 20% Amuchina for 1 liter of demineralized, distilled water and left on longer to remove algae and fungus growth. Special EDTA solution applications (50 g/liter) were made to remove stubborn rust stains near metal inclusions."[37]

[36] From personal interaction with Signore Fantoni, a former supervisor of wellhead restoration projects

[37] Carrera, Fabio. Preserving Venetian Art. EARTHWATCH Field Report. October 1997. p. 6

3.7.3.2 Biological pack

The biological pack cleaning system is used to clean stone surfaces. A cloth containing microorganisms is placed over black grime, and the organisms theoretically digest the undesirable substances without harming the stone. It is a very slow process and the packs are left on for several weeks, causing practically no damage to the stone.

3.7.3.3 Water-Based

Water is used in several cleaning processes. One method is to sprinkle a mist of water onto the surface for many hours, causing the dirt to saturate with water and loosen from the stone. This method can be effective, but is labor intensive, requires a large amount of scrubbing and can often cause water damage to the surface. A high -powered water stream is another method by which to clean the stone, but can also cause water damage and erosion.

3.7.3.4 Sand Blasting

Sand blasting is a method that works well on non-detailed surfaces. This method can be hard to control, and causes rapid pitting on the surface of the stone, making it more susceptible to erosion. It would be ill advised to use on the delicate carvings of the Venetian wellheads, or any public art in which detail must be preserved.

3.7.3.5 Lasers

Lasers can remove encrusted dirt very well, but the process is extremely expensive and time consuming.[38] In order to use lasers, laboratory conditions are required as not to accidentally damage the surface being cleaned. It maybe possible to relocate a wellhead and take it to a laboratory for detailed restoration. This process would be extremely expensive and impractical, since the wellheads are permanent structures, often very large and very heavy.

[38] Ibid.

3.8 Vere da Pozzo di Venezia

The main source of information for our project is the book entitled *Vere da Pozzo di Venezia* or *The Well-Heads of Venice* by Alberto Rizzi. See Figure 3-17 for a picture of the cover. We used this book as a guide and a reference to finding the history, material, and location of each wellhead. The photographs contained in this catalog proved to be a convenient tool when trying to locate a particular wellhead when there were many in a small area. We also used the numbering system in the book as our official numbering system for all 232 wellheads in Venice proper.

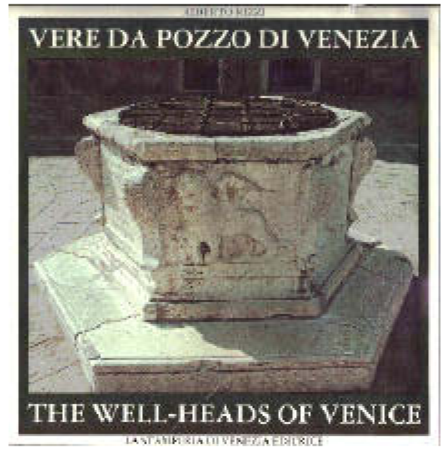

Figure 3-17 - The Well -heads of Venice

3.9 Summary

In every society, the traditions and cultural tre asures are preserved through its people and artifacts. It is through them that we can better understand and appreciate the history of nations. Venice's need for preserving heritage is just as important as other cultures. As an artifact of culture in the most literal sense, the wellheads serve to stand as monuments to the history of Venetian survival in the lagoon.

Many wellheads have fallen victim to vandalism, deterioration due to weathering, and poor preservation plans. A lack of an adequate record -keeping system for the wellheads makes it difficult to keep track of condition and location. All of these factors help contribute to a loss in Venetian history. There is clearly a great need to preserve these wellheads even if they are no longer function al, and recognizing that need is the first step to positive action. The wellheads capture the artistic styles utilized by the early Venetians, the skill of Venetian craftsmen and the technology used in solving the problem of a lack of drinkable water. Th ese areas, which clearly show the character of the early Venetian people during times of hardship, can be used as reminders and lessons for future generations of the spirit of Venice.

Chapter 4 - Methodology

The primary goal of this project was originally to catalog the wellheads in San Marco, San Polo and Santa Croce, and incorporate this information with that from the 1995 WPI wellhead project team, and the 1996 and 1997 EARTHWATCH project teams. In our interpretation and understanding of the project however, we used the previously performed projects as a model to structure a comprehensive study of all the public Venetian wellheads in Venice proper.

This project serves to aid in and promote the preservation of Venetian wellheads by creating a resource in the form of a comprehensive public Venetian wellhead catalog. The catalog may be used in building efficient restoration strategies.

This chapter begins with logistical planning and the strategies put into practice, to collect significant data that will later be used to draw conclusions through statistical analysis. We continue by discussing the actual techniques used during fieldwork to maintain consistency and the method by which we organized the data as to allow for ease of use. We then conclude the chapter with the preliminary strategies used to build some of the aids we produced to promote public awareness including web pages, educational program for teachers, and self-guided walking tours.

4.1 Pre-existing Information

In 1981, Alberto Rizzi published a book entitled *Vera da Pozzi di Venezia*, which included extensive research focusing on public Venetian wellheads such as information on material composition, individual histories and location. As far as our research team could discern, the study was unprecedented and served to aid all three subsequent research teams in 1995, 1996, and 1997. *Vera da Pozzi di Venezia* was a comprehensive catalog of public Venetian wellheads; however, it lacked information on wellhead state of conservation. In order to learn more about preserving the wellheads, we must first determine their current condition and if possible, more on the nature of the deterioration.

State of conservation data for three *sestieri* existed from the thorough cataloging efforts of EARTHWATCH and the 1995 WPI wellhead project teams. Although the studies appeared genuinely well-executed, the data from the three different teams was incompatible with each other for several reasons.

To begin with, at the time we conducted our field study, three years had passed since the last damage assessment had been made, and five years from the first assessment. During this period of time, the state of conservation might have changed. Although this might be determined by re-assessing a sampling of the previously recorded wellheads, that would assume we could reproduce the rating scheme the previous team used, perfectly. Since most of the information collected is a direct result of an individual's personal visual assessment, we decided that the only way to ever have a useful, complete computerized catalog would be to perform all the necessary data collection in a single study.

The most useful information that existed on the wellheads prior to our field study was the number assigned by Alberto Rizzi to each wellhead which we w ill henceforth refer to as the Rizzi Number and the photographs included in his catalog, *Vera da Pozzi di Venezia* .

4.2 Magnitude of Study

In 1981, there were 232 documented public wellheads located in Venice proper. [39] These did not include wellheads that were classified as private, had been removed or destroyed, or existed on the outlying disconnected islands of the Venetian lagoon. We confined our area of study to include all 232 public wellheads originally recorded by Alberto Rizzi throughout the six *sestieri* and Giudecca. Figure 4-1 shows the distribution of the wellheads per *sestiere* originally cataloged in *Vera da Pozzi di Venezia* in 1981.

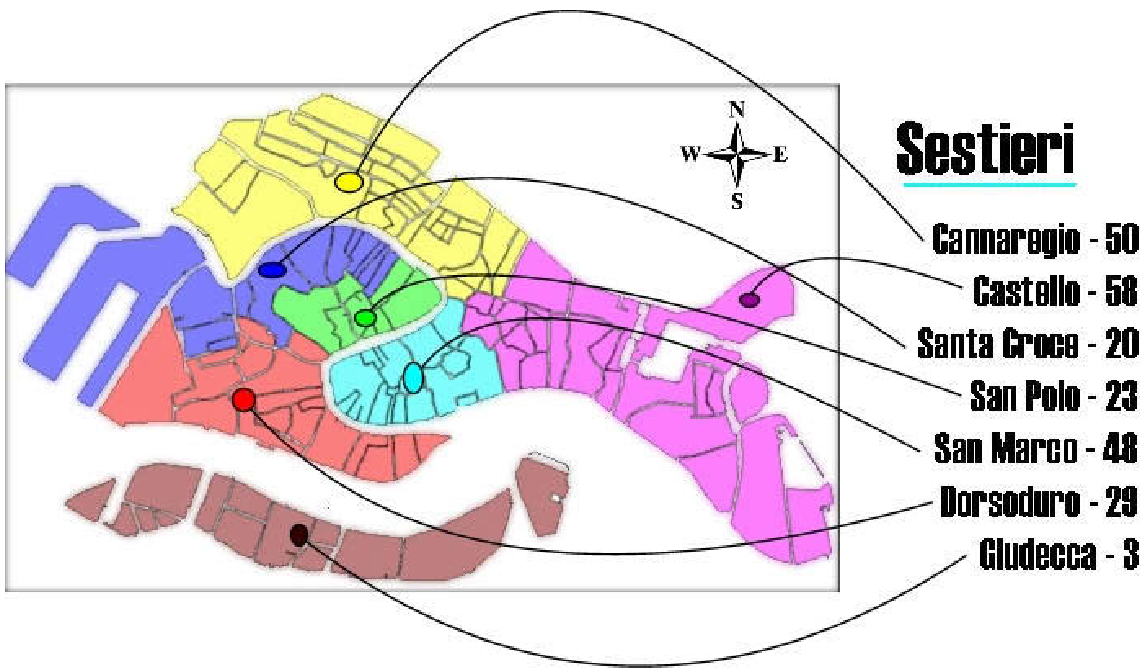

Figure 4-1 Wellhead Distribution by Ses tiere

The data of particular interest to our research team was the state of conservation of public Venetian wellheads. By assessing the extent of deterioration and translating it into numerical values, we could later use a computer to perform all -inclusive comparisons. (See Chapter 6) As recognized by previous research teams, attempts to make such complex evaluations without a computer would be nearly impossible. Separating directionally specific information by sides and corners allowed for exceptional detail in determining not only extent, but also location of damage, however it also severely increased the

[39] Rizzi, Alberto. The Well-heads of Venice. Stamperia di Venezia Editrice, Venezia 1981

magnitude of information obtained. We collected a total of approximately 30,000 numbers and notes which had to be organized into a database. The volume of data we collected was greater than in prior studies conducted with similar time constraints, and therefore we were forced to create a new methodology for data collection processes in order to reach our goal in time. However, it is important to note that we would not have been able to accomplish what we did without the exemplary guidance of the previous project teams.

4.3 Navigating the Sestieri

One of the biggest obstacles to field data collection was actually locating the wellheads. Even with detailed MapInfo[40] maps (See Appendix E) generously provided by Professor Fabio Carrera, it was difficult to find the most direct path to each site while in the streets of Venice. Professor Carrera was an advisor on the project, but was also familiar with the EARTHWATCH study from first-hand experience. Subsequently, he was able to aid us in locating two wellheads that were placed incorrectly on the map, which we later corrected and included on the CD-ROM packaged with this report.

Although technology has allowed for great leaps in convenience and efficiency, we found that simplicity and portability in the form of printed maps was most appropriate for our purposes. By using MapInfo, we pinpointed the locations of the wellheads in each *sestiere* and created detailed maps for use in daily cataloging.

We used a simple, symbolic system to keep track of the basic important information beginning with a dot pinpointing each wellhead. As we located each wellhead, we used a circle to denote the necessity for early morning photography, as would occur with outdoor restaurants that included a wellhead within the boundaries of the dining area. An "X" was used to denote that the wellhead has been recorded or an "M" for missing wellheads we could not locate. We eventually visually confirmed the locations of 231 public wellheads originally cataloged by Alberto Rizzi. (See Chapter 5.)

4.4 Data Collection

This section outlines the thought processes that went into determining the fastest and most effective way by which to catalog all the public wellheads of Venice proper. By focusing on the actual data collection methods throughout the study, we were able to identify and minimize inefficiency. We begin with the most controversial topic of defining how to record state of conservation, which normally varies from individual to individual, but by using constant communication between team members, we effectively eliminated the randomness of this process. It is also this lack of communication with past research teams that makes their data incompatible with subsequent studies. This is the main reason that necessitates an all-inclusive investigation of public Venetian wellheads.

[40] MapInfo Professional Version 5.5 © 1985 – 1995 MapInfo Co. MapInfo is a software program used for creating and displaying maps using layers.

4.4.1 State of Conservation

The previous EARTHWATCH and WPI project teams rated many types of damages. These included accretions, missing pieces, cracks, grime, rust, algae, pitting, flaking, chalking, and consumption. All sides were assessed for each type of damage, by the percentage of coverage, the severity of that percentage, and the severity of the remainder. Severity and remainder were scaled between zero and four. Zero represented no damage at all and four represented the worst possible case. Consumption required special attention when applied to figures, or carvings of people, which was usually at a level of complexity beyond that of most wellhead features.

We attempted to use a slightly modified field form in the sense that it was formatted for easy entry into our database, but the information collected was essentially the same. Once we applied this method on ten wellheads, we realized that even our best time was no less than forty minutes at an average of one hour, including fifteen minutes of travel time from the previous wellhead. Furthermore, the numbers we were getting were difficult to reproduce even for an individual who had made the assessment. Part of the problem was the thinking involved in attributing a number to a certain percentage of the side, then switching back to thinking about a number while trying to ignore the most severe coverage just assessed. We needed a better system of data collection in order to reach our goal, but it could not sacrifice useful data in the process.

After discussing the problem with Professor Carrera, who had much prior experience with state of conservation, we identified that the most important information was where and how much of the surface was covered. Severity has a limit in a sense that at the point where it gets bad enough to be considered higher, it has also spread across the surface. Therefore, we generated a new data collection method focused on coverage, with a division of three areas per side or corner assessment. See Figure 4-2 for a comparison of the two methods of damage assessment.

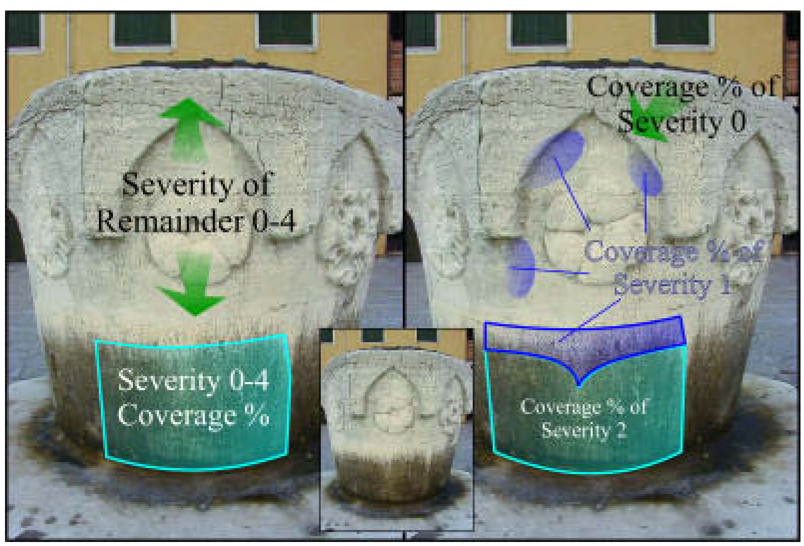

Figure 4-2 1997 EARTHWATCH versus 2000 WPI Damage Assessment

We divided each section of the wellhead into three areas, defined by a pre-determined level of severity. During evaluation we would assign percentages of coverage to the moderate and high levels of severity for each type of deterioration, with the coverage of the remainder implied. For the purposes of keeping our data consistent within our study, this method was simple to use and lowered the likelihood of human error. Determining the coverage in one more division than before was easier for the team to do consistently, and did not sacrifice on the most critical fields of specificity of the data, which we had determined to be coverage and location. Performing this type of assessment on each side and corner while recording the degrees away from north allowed for the data to be directional in nature, also, thereby satisfying our requirements.

The types of deterioration for our field form also changed from the previous teams. We thought that many categories could be combined, since the nature of the damage was similar to the point that differentiation was superfluous. Our final deterioration definitions were composed of the categories listed in Table 4-1.

Damage Assessment	
Accretions2	Paint accumulations usually caused by graffiti that obscures the surface of the wellhead completely
Accretions1	Paint accumulations that are sporadic as in the edge of spray paint marks or tiny spattering that still allows the wellhead surface to be seen under it
StructuralCracks	Any cracks which are deep into, or all of the way through the wellhead wall; potentially causing severe structural damage
SurfaceCracks	Minor cracks located on the outermost surface of the wall
Grime2	Grime, dirt, and sulfur accumulations that are pervasive to the point of completely obscuring the wellhead in coverage
Grime1	Grime, dirt, and sulfur accumulations that are light enough to still see the stone surface
SurfaceDamage2	Heavy damage to the surface; includes missing pieces
Surface Damage1	Light damage to the surface; includes pitting, chalking and flaking
Algae	Biological plant growth which slowly digests the stone and/or widens microscopic cracks causing damage

Table 4-1 Damage Assessment Criteria

Furthermore, we decided to essentially ignore damage that had been previously repaired since we optimistically assume that little can be gained by restoring previous restoration. Simplifying the field form, made collecting, as well as entering data, more efficient.

4.4.2 Quantifiable Measurements

All dimensional measurements could be recorded directly since the wellheads were, for the most part, in easily accessible public areas at ground level. Specifically, Table 4-2 describes the information that we were able to record directly in terms of magnitude.

Wellhead Dimensions	
CircumferenceOfBase	Measurement in centimeters of the base of the wellhead where it comes in contact with the platform or ground
HeightFromBaseToRim	Height measured in centimeters from the base of the wellhead to the top, excluding the lid if applicable
WellheadWallThickness	Measurement of the distance in centimeters from the outside of the wellhead wall to the inner wall
PlatformWidth/Circumference	Width and/or circumference of the platform as measured in centimeters
PlatformHeight LidCircumference	Height of the platform measured in centimeters Circumference of the lid measured in centimeters
LidDiameter	Diameter of the lid measured in centimeters

Table 4-2 Directly Accessible Numeric Measurements

To acquire non-linear measurements such as circumference, we marked an inelastic cord in one hundred centimeter (1 meter) increments. By counting off the marks and measuring the remainder with a tape measure, we could quickly and accurately acquire the perimeters of the lid, base and platform without taking multiple measurements or using geometry to make approximations.

We also recorded the angle perpendicular to every side and corner of each defined section. Using a compass, we determined the angle of the north-most side of the wellhead and each subsequent side in a clockwise direction. These angles allowed for later analysis creating theories on directionally consistent damage sources such as sunlight and weathering. Even in the case of assessing a square wellhead, we took exact measurements since the sides are not always at ninety-degree angles. (See Appendix B for a detailed listing of the measurements taken.)

4.4.3 Fieldwork

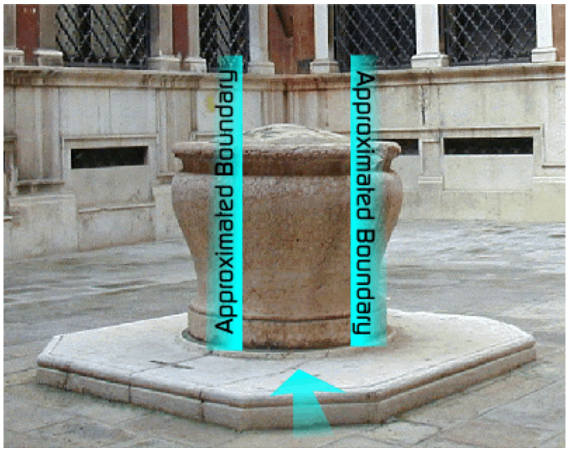

Figure 4-3 Definition of Side by Platform Shape

For the first week of data collection, the team went into the field as a whole for seven to ten hours per day to ensure that fieldwork would be completed within the allotted time. We knew we had to maintain an average pace of ten wellheads cataloged per day and no less to meet our deadline.

We separated the days by *sestiere* to methodically cover Venice, guided loosely by the Rizzi numbering system. After locating the wellhead, the data collection team divided the wellhead into logical sections by sides and corners. Most had a definite number of sides, but the circular wells were usually broken into four or eight, depending on sections in the platform. Figure 4-3 illustrates an example of how we dealt with circular wellheads. In the rare case that there was no easily distinguishable marking to denote separation of sides, we used the compass to divide the wellhead into equal sections. Corners were only recorded as such if they were more than the intersection of two sides in terms of decoration, or could not be easily included in the assessment of the two adjoining sides. One of the more common definitions of a corner is pictured in Figure 4-4. The corner is defined by the intersection of the two sides near the top of the wellhead, but features a type of arch-like area smaller than that of the other sides.

Once the wellhead had been divided into sections, two members wrote down the general information including the circumference of the base and lid of the wellhead, height of the wellhead, along with other numerical measurements. (See Appendix B for detailed list of definitions.) While this was taking place, one team member used the compass to determine specific angles of all sides and corners of the wellhead for reference and analytical purposes. Another team member took all of the digital photographs necessary for the database, and the final team member recorded all of the data that was being collected by the other four members. Then the team members randomly selected a side and reported the percent coverage of each type of

Figure 4-4 Identification of Corner

deterioration to the member who was recording.

To ensure that we would maintain a consistent assessment of wellhead state of conservation, we took our entire project team to a wellhead and performed a run-through of the data collection process. Each person evaluated a side without the other team members watching, and then discussed the disparities. When we came to a consensus on the correct damage assessment, we implemented the method in the field while still occasionally double checking our output. We felt that this was valuable in maintaining consistency throughout our data collection and after cataloging several of the wellheads as a group; the similarity in judgment did not seem to change.

After completing the cataloging of approximately sixty wellheads, we felt that every team member had a clear-cut idea of how to identify the correct coverage of damage. We divided the team into three parts, consisting of two assessment teams and one photographer. The photographer could work faster since there would be no waiting for the other team members to finish taking measurements and move out of way. Prior to this division, three team members would concentrate on learning the scale by which other team members judged state of conservation. After each member was confident that they could reproduce a consistent judgment on the same level as the other three, a large group was no longer necessary. The subsequent separation into two data collection teams allowed for an almost doubled rate of cataloging. This made it possible to complete the six *sestieri* in the time allotted while still maintaining confidence that the data collected was consistent.

4.4.4 Photographic Documentation

The photographs have several functions aside from rounding out the database. In years to come, it will be possible to identify visible changes in the state of the wellheads and draw time-dependent conclusions. They can also be used as a reference to get an idea of our judging scale. The high resolution of the photographs may even succeed in substituting for an inability to evaluate the state of conservation first-hand.

4.4.4.1 Goals

In reviewing past projects, we found it difficult to find specific photographs even when sorted and filed in separate envelopes. In addition, many photographs were blurry, badly lit and/or had been incorrectly developed. We realized that this was likely caused by not being able to review the quality of the pictures before developing them. In response to this, we selected a digital camera with an LCD screen that could be used to review pictures immediately in the field and allowed for digital enhancement and the ability to sort and search through them on a computer.

4.4.4.2 Techniques Used

Different times of the day would provide different lighting conditions for the wellheads, which would be very difficult to circumvent unless only a few photographs were taken at the same time each day. Since this was not feasible for our schedule, we decided to use camera settings and graphic editors to simulate similar conditions. It turned out that the best times to photograph wellheads were early in the morning from 6:00am to 7:30am, in the middle of the day from 11:00am to 2:00pm, and from 5:30pm until just after sundown. Using a monopod to steady the camera was critical to taking clear pictures. A few were taken without the use of such a device and had to be retaken later.

It was decided that using the built-in flash to take pictures at night would not produce consistent pictures, but using a fill flash would bring out better definition during the day when dark shadows would obscure parts of the designs.

Considering that wellheads may have been destroyed or privatized, we could not assume that every wellhead would be accessible to the photographer. Even when physically accessible and not behind a locked gate or other impassable barrier, certain sides or corners may be obstructed by walls or construction which is prevalent in the city. Our solution for these cases was at the very least, to take a single area photograph of the closest point we could reach. By doing this for privatized wellheads, we made it easier for future research teams to conduct private wellhead investigations.

4.4.4.3 Photographic Resolution and Storage

Considering that all public wellheads could be visually broken into some combination of four to eight sides, four to eight corners, a lid and surrounding area photograph of the 232 remaining public wellheads, we took a grand total of around 2500 digital photographs. We decided to use the highest quality settings of the camera available, which set a resolution of 1280x960 pixels at about 20% compression in JPG format. See Figure 4-5 for a comparison of resolutions. Furthermore, to make the best use of the resolution, we filled the frame with as much of the surface as possible, by sometimes rotating the camera. In order to prevent confusion, we later rotated the photographs back to their appropriate orientations and resaved them at the same quality.

Figure 4-5 640x480 versus 1280x960 pixel Resolution Comparison

Each photograph required about 200 kilobytes of storage space, which would suggest that the total photographic archive would take up approximately five hundred megabytes, easily storable on a CD-ROM. We first created 232 directories in which to hold the photographs, then moved the appropriate directories into 7 folders labeled by *sestiere* (including the Giudecca).

4.4.4.4 Searching the Photographs

Being able to search the photographs would be an important part of making them useful to subsequent research teams. We realized that it would be best not to depend on a single program to accomplish this, so we created a naming system to simplify sorting to a syntax-based method of identification. The Microsoft Windows "Find" command or MSDOS "DIR" call can be used from the main directory of the photographic archive to sort and copy the desired groupings of photographs to new folders where they can be reviewed with any graphic browser.

Examples of the most useful "Find" command entries are listed in Table 4-3. The first three characters of the file name identifies a photograph by the Rizzi identification number attributed to it. This allows for searches on specific wellheads by Rizzi number. The camera saved all the photographs in optimized JPG format which, when specified within a search, will prevent file folders from appearing. We used consistent symbolism to denote sides in terms of letters of the alphabet and corners denoted by adjoining sides such as AB, BC, CD, etcetera, mirroring the field form. In some cases, the number of sides and corners are higher than four and therefore require use of later letters in the alphabet. Since the file names for sides have four characters, a search for "????.jpg" will yield all side photographs, just as the exclusively five character names of the corner photographs can be separated out by using "?????.jpg". Lid and area photographs were defined in the same fashion as sides and corners, but instead of alphabetic representation, we used the word "lid" or "_area" to make sure that they would be set apart from the sides that could only be labeled as far as "H" in the alphabet. Without the underscore ("_"), area photographs would show up from searches for sides labeled "A." Lastly, the Olympus D450 camera we used, named photographs automatically as "P" followed by the date and number of the photograph.

"Find" Syntax	
*.jpg	Finds all photographs
108*.jpg	Finds all the photographs of wellhead with Rizzi #108
????.jpg	Finds all side photographs
???A.jpg	Finds all side A photographs
?????.jpg	Finds all corner photographs
???AB.jpg	Finds all corner AB photographs
???lid.jpg	Finds all photographs of wellhead lids
???_area.jpg	Finds all wellhead area photographs
P*.jpg	Finds all extra photographs

Table 4-3 "Find" Photograph Search Syntax

We placed photographs that were not specifically relevant to the catalog, but contributed to knowledge about the wellheads or special features, in their appropriate folders.

4.5 Database Structure

The main objective of this project was to create a complete computerized database, whose purpose was to stand as a basis from which to do further research on probable causes of deterioration and to find solutions through statistical correlation and inspection over time. Correct utilization of the information that this database contains will allow for restoration prioritization and various forms of damage assessment.

4.5.1 Sub-Sections

The data we collected was archived in a database structured similarly to that of the 1995 WPI project and the EARTHWATCH projects of 1996 and 1997, with many modifications. The database containing all of the information for the public wellheads is divided into seven sub-sections for simplification (See 0Results). They are as follows: (See Appendix B for detailed definitions)

I. **Basic Information:** contains general information on the wellhead in terms of identification and location, wellhead specifics, platform specifics, lid specifics, importance factors and miscellaneous notes in terms of material, shape, orientation, and dimensions.

II. **State of Conservation (Sides):** contains specific information about each side of the wellhead in terms of the deterioration classified by direction.

III. **State of Conservation (Corners):** contains the same information as the side database applied to corners of the wellheads.

IV. **Consumption of Human Features:** contains very basic information on the state of carved human figures located on the sides of some of the wellheads. The condition is rated on a three level scale of "good," "going," or "gone." This is a relatively effective way to quickly tell how fast details of the human figures are deteriorating, and helps to identify rare and valuable images of people before they wear away completely.

V. **Improper Use:** contains notes on improper usage, including graffiti, observed during fieldwork. Examples of this would be the existence of a restaurant that used it as a serving table or part of a dining area layout. We do not intend to pass judgment on the choices of these vendors, but rather wish to help identify possible threats whether accidental or that which could be prevented.

VI. **Rizzi Information:** transcribed directly from the original wellhead catalog by Alberto Rizzi entitled *The Well-Heads of Venice*. This sub-section is composed of information that remains constant, such as date, location, and measurements.

VII. **Special Details:** contains all notes taken during fieldwork that did not fall into a pre-specified category, such as designs of carvings, inscriptions, the existence of water dishes, and types of metal accessories.

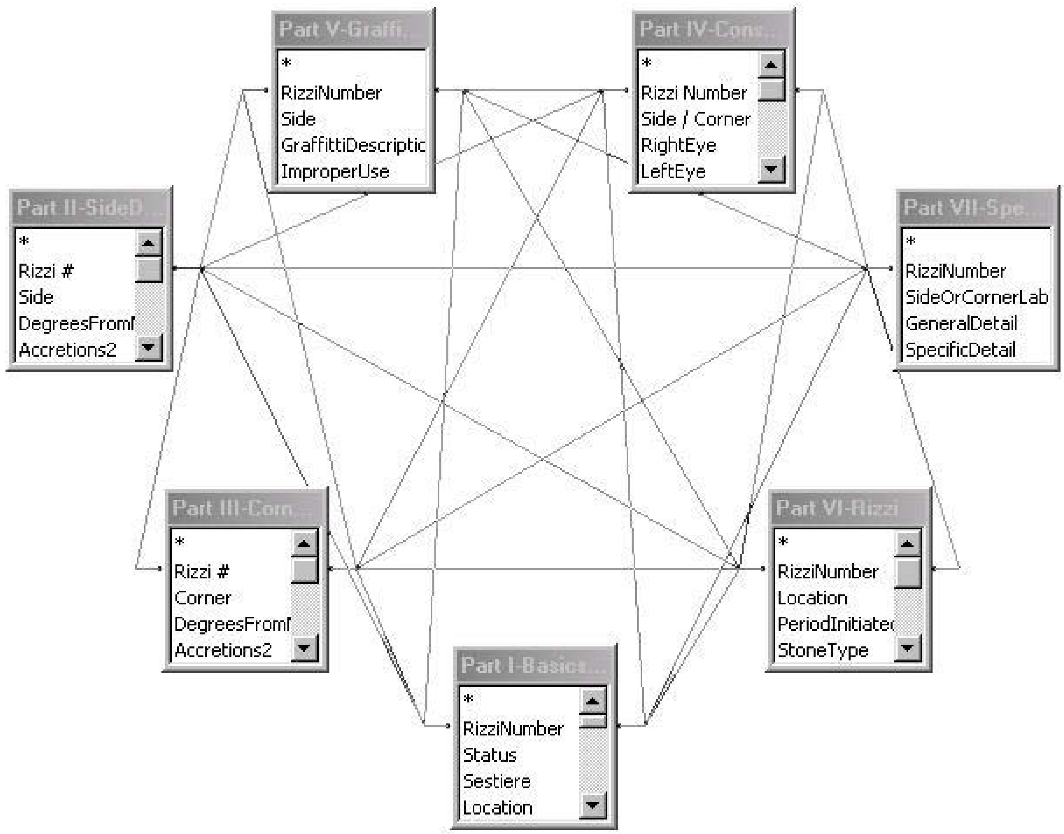

Figure 4-6 Database Linking by Rizzi Number

Dividing the database into seven parts made it much more manageable for both the user and the software we used. Microsoft Access only allows for 255 columns of information per database file, but the sides, corners and basic information alone would require 258 columns. One can still create a query to search all the sub-sections simultaneously, so in our cas e, having a single section would present no real benefit. See Figure 4-6 for a schematic diagram of the database. The lines of the schematic denote the linking between sub-sections, which we accomplished by using Rizzi numbers.

4.5.2 Creating an Illustrated Catalog

Microsoft Access also has the drawback of a file size limit. Once an Access file reaches a size of around 1 gigabyte, it becomes difficult to deal with in terms of instability when opening or accessing the file. In order to avoid the problems associated with this limitation, we used Microsoft Visual Basic to link the database to the 2124 photographs, which would have been nearly impossible using solely Microsoft Access. We had very little experience with Visual Basic, howe ver our advisors recognized the benefits of the program early on and provided us with external aid. After we developed the initial layout, we passed it on to an experienced programmer to implement the linking and functionality.

The final product is a user-friendly version of our database, which is the result of all of these combined efforts. This catalog will provide quick and easy access to information about the public wellheads of Venice for future organizations, and can aid in planning their preservation efforts.

4.6 Public Awareness Tools

The public Venetian wellhead catalog is a valuable resource of information for use in restorative efforts, however in order to perpetuate the effort, motivation and funding is required. This can be indirectly accomplished through raising public awareness and subsequently, interest. Opening the lines of communication between organizations already interested in preserving Venetian wellheads and allowing the public to learn enough to become interested in the future, are the primary methods by which to get the public involved. Working in conjunction with the 2000 WPI External Sculpture project team, we created web pages, a combined self-guided walking tour, and an educational program.

4.6.1 PPAV Web Pages

The Internet is currently a cheap and relatively simple way by which to reach people all over the world by making information accessible 24 hours a day. We designed a layout and implemented the basic design of the first PPAV web site. The PPAV or Preservation of the Public Art of Venice is a sub-section of the VPC (Venice Project Center) currently building their foundation. By providing this organization with some of the first useful information to make available to the public, we can effectively help them initiate networking with other organizations on the Internet.

The content of the web pages focuses primarily on getting other organizations in contact with the PPAV for information and to offer support. Our immediate goals for promoting the preservation of public Venetian wellheads can be realized subsequently by gearing the web page design toward the broader, parallel goals of the PPAV.

With the intention of perpetuating research in the area of wellhead deterioration and to encourage further studies in the future, we will include this report, along with as much guidance as possible, in a sub-section of the PPAV web pages. General background information on the wellheads including tourism information, pictures, maps and tours will inform the public at large on the existence and plight of public Venetian wellheads. The finalized design of the web pages is included in Appendix L.

4.6.2 Walking Tours

In order to increase the awareness of the public wellheads of Venice, we created a walking tour that includes some of the more artistic and historic pieces throughout the city. Although there are already a large number of tours through Venice on a daily basis, few include information on wellheads. The easiest way to draw attention to these commonly overlooked pieces of public art was to incorporate them into an existing tour. We created supplements to three self-guided walking tours provided by the Azienda Di Promozione Turistica. These supplements include information on external sculpture and wellheads that are on the existing tour. (see Appendix C)

We also designed a self-guided walking tour exclusively for public Venetian wellheads. (see Appendix C) This walking tour is divided into two sections, covering twelve wellheads over approximately four kilometers. The first portion of the tour begins in St. Mark's square, which is an area commonly known by tourists and leads them through the *sestiere* of San Marco to the Rialto Bridge. The second portion of the tour leads them through Cannaregio to the Ghetto, a beautiful area most tourists do not get the opportunity to visit. This leads tourists away from the high traffic areas while educating them about the wellheads of Venice.

These self-guided walks are meant to serve as an example for tourism agencies to create their own, but are complete and thorough enough to distribute in terms of content. By walking these tours ourselves, we confirmed that the routes are valid and enjoyable, but they may require reformatting to suit the level of professionalism in graphic design that we could not achieve with our limited resources.

4.6.3 Teaching Tools

Education is a fundamental tool for promoting public awareness. By focusing on the youth of Venice, we can secure the future of the wellheads and public art in general by decreasing ignorance that leads to vandalism and apathy. We developed an educational program to provide teachers with guidance in building lesson plans pertaining to often overlooked pieces of public art in Venice.

The program begins with background information on wellheads and external sculpture in order to prepare teachers for potential questions posed by children. This information comes directly from research performed in the course of completing both this and the 2000 WPI External Sculpture project. It goes in-depth on topics such as the inner-workings of the cistern, water supply, history, materials and artistic styles. By providing extensive information to teachers beyond what they require will help them feel confident in teaching the subject.

After educating the teachers with adequate background information, they may begin introducing the students to the content through classroom instruction geared towards educating the children in an intriguing manner. As the students become more comfortable with the material, the teacher may make a transition to the second phase of the educational program: hands-on education. This allows children the opportunity to experience public art in a guided learning environment. Specifically, field trip, project, and game ideas are included for teachers to use directly or as a reference from which to build their own hands-on activities. The final phase of the educational program is to review the subject matter with the students. By obtaining feedback from the students in the form of writing, talking, and a final collaborative art project, the teacher can discern the extent of comprehension and interest. From this information, the teacher can decide if and how to execute the program with future classes.

4.7 Summary

The procedures we used to complete the 2000 WPI Public Venetian Wellhead Catalog were very different from those used in previous projects. At certain points, it seemed as if the stress and workload would be too much to bear, but by constantly reviewing our methods, we were able to optimize our efficiency and complete the necessary fieldwork. This chapter may even be considered excessively thorough, but it is only due to empathy for subsequent research groups and as a grateful acknowledgement to previous ones. Without the tested methodologies of the 1995 WPI Wellhead project, and the 1996 and 1997 EARTHWATCH studies, this project would have been nearly impossible to complete within our timeframe.

Chapter 5 - Results

Keeping in mind that the ultimate purpose of this project is to promote the pr eservation of Venetian wellheads, anything that informs us about the nature of threats facing the wellheads will eventually contribute to building a more effective strategy for preservation organizations. The public wellhead catalog is the largest and by far most complex of this project's results and it is through its graphical simplification that we and subsequent organizations can proceed toward the more immediate goal of understanding the state of conservation of public Venetian wellheads. It is what o ne uses the numbers for that defines the usefulness of the numerical data. Although we had collected numerical values to represent the 1168 sides and 556 corners of the 217 remaining public wellheads, without a way to represent the data in a format that c onveys a message, the 31731 numbers and notes in the wellhead database would just be 31731 numbers and notes.

This chapter is structured in terms of the sub -sections of the database, beginning with Basic Information and continuing through Sides, Corners, Consumption of Human Features, Improper Use, Rizzi Information and Special Details. To begin demonstrating the usefulness of the database, we reorganized the data into graphical models that quickly communicate trends and separate the information into digestible sections prior to our analysis of what we determined to be the most important information.

5.1 Wellhead Database

The data we selected for entry into the data base was based on three major criteria: First and foremost, information that could give insight into the reasons behind deterioration was required to create a method to prioritize the preservation efforts to the most endangered wellheads. Secondly, any information that could directly help in creating an algorithm to compare levels of deterioration among the wellheads was critical in assessing the wellheads' current state. The fact that fifteen public wellheads have turned private since 1981 may prove to b ecome useful in the future and can help research teams and organizations determine the rate at which the wellheads are becoming consumed by their environment.

We visually confirmed the existence and locations of 231 of the public Venetian wellheads, including 217 public and 15 privatized wellheads. We made it a point to confirm visually, wellheads that were located behind locked gates and within construction zones. Only one of the wellheads was completely inaccessible due to construction (See Figure 5-1). We obtained detailed information on the public wellheads and recorded only location and status for privatized wellheads.

Figure 5-1 Inaccessible Wellhead (Rizzi #17)

5.1.1 Digital Photographs

In addition to the quantifiable data, we also generated 2124 high quality, 1280 by 960-pixel resolution digital photographs of wellhead sides, corners, lids, and areas that archive the current state of conservation in a visual format. By using a level of compression that allowed for minimal distortion and implementing an organized naming system separated by *sestiere* and Rizzi numbers, the photographs on their own allow for countless possibilities even without the use of specific database browsing software.

There are a few disparities between the actual number of pictures and database entries due to splitting into three groups without being able to communicate. Wellheads that had sides or corners obscured by obstacles such as construction or walls were photographed to the best of our ability, but in some cases, a picture that reflected the condition of the side was impossible to obtain.

5.2 Basic Information

The Basic Information sub-section of the database primarily contains information that was not specific to side or corner deterioration assessment, including values on dimensions and features of the wellhead, platform, and surrounding area. Values could be numerical with inferred units such as the height, length and width measurements, be true or false as with the existence of rust on the surface of the wellhead, or text fields for notes and location. There are a total of 34 fields of data per wellhead in the Basic Information sub-section. Appendix B lists these fields with their definitions and type.

5.2.1 Identification and Location

We used the identification numbers from Alberto Rizzi's book, *Vere da Pozzo di Venezia*, to differentiate wellheads in honor of his efforts in the field of art preservation. The Rizzi numbering system functioned very well and by refraining from creating a secondary numbering system, future field data collection teams will have more than one reference with the same numbering system to maintain consistency and simplicity.

We recorded information on the specific and general whereabouts of each wellhead directly from *Vere da Pozzo di Venezia*, and followed up by confirming each location from address signs and maps during fieldwork collection. The specific area locations will be available for use by subsequent research teams to find the wellheads. The *sestiere* database field is more useful for analyzing the wellheads by groupings to get an idea about their density and distribution.

Furthermore, the mapping software package we used to navigate through the winding streets of Venice (See Figure 5-2) would have been useless without the maps provided by the

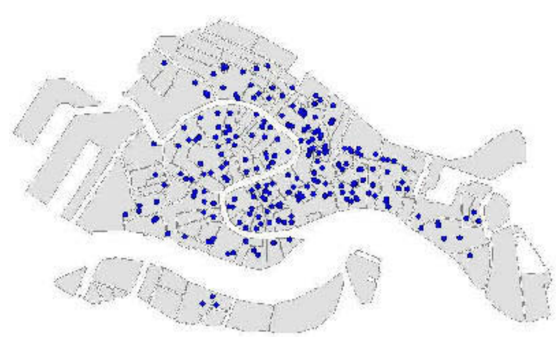

Figure 5-2 Wellhead Density Map

PPAV (Preservation of the Public Art of Venice). However, we found minor errors existed on the maps in the form of a few incorrect locations and missing Rizzi numbers. With the aid of Fabio Carrera, who was familiar with the locations from prior experiences with the EARTHWATCH research team, we corrected the disparities we found and created new maps (See Appendix E.)

5.2.2 Measurements

In order to get an idea of the usefulness of public wellhead dimension measurements, we focused primarily on the scope of the data to set realistic bounds for later analysis. Calculating standard deviation or performing in-depth statistical analyses on the dimensio ns alone was deemed to be relatively superfluous in terms of our purpose. For example, by using the circumference of the wellhead base and height from base to rim measurements to calculate the approximate volume of the 217 public wellheads, we can deduce the relative size relationship distribution as can be observed from Figure 5-3. The minimum and maximum volumes range from 0.75 to 21.88 cubic meters, respectively and the distribution is biased toward the lower e nd of the range at an average of 4.71 cubic meters. It stands to reason that in terms of a cost estimate, wellheads at the low end of this scale will generally require less time and resources, but it would likely pale in comparison to other factors.

Determinant values that define the shape of the wellhead such as whether the top and bottom of the wellhead is circular, and the number of sides (if applicable), can be used in conju nction with the dimensional data to aid in creating accurate maps and models of wellheads. However, little can be gained from comparing the number of sides and shapes of the wellheads in terms of promoting conservation.

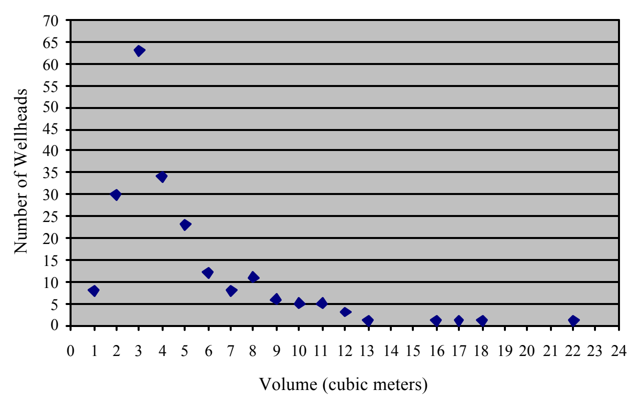

Figure 5-3 Wellhead Volume

As far as platform dimensions are concerned, 192 of the public wellheads had visible platforms, 166 of which were circular and 50 were square, hexagonal, or octagonal. A single wellhead platform had 16 sides, which belonged to the largest wellhead in Venice located in Campo S. Polo, measur ing 21.88 cubic meters.

Once again, the shape and dimensional data may be used for mapping and modeling, but unlike the wellheads, the platforms are at a slig htly more drastic risk since, as a result of construction, they occasionally become part of the campo floor. The overall average platform height was 14 centimeters, but that includes 6 platforms that were flush with the ground (not counting non -existent or non-visible platforms). The material of the campo around these 6 platforms appeared to be relatively new additions in relation to the age of the wellheads; therefore the record of the platform width/circumference and its height has an additional archival significance that was not previously available. From this point forward, future construction around public wellheads that engulf the platforms can be recognized. Currently, the distribution of platform heights separated by number of steps follows that of Figure 5-4. The labeled points denote the average height of the platforms with the specific numbers of steps. As construction and the raising of campo floors continues in response to rising floodwaters, steps will continue to disappear from built-up campi, and this distribution will shift to the left side of the graph. This suggests that further investigation of ground-level threats may be necessary.

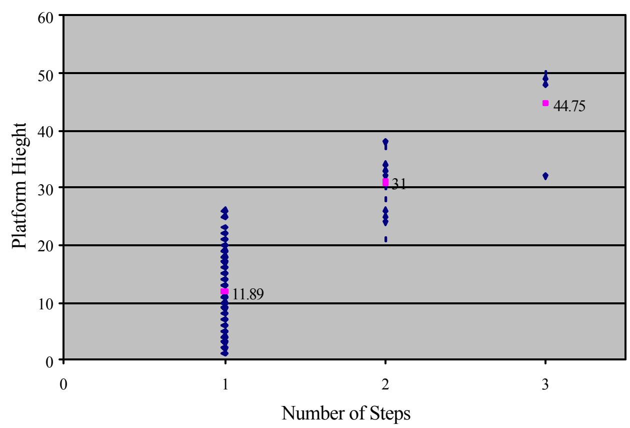

Figure 5-4 Platform Height by Number of Steps

The dimensions of the lid in terms of diameter and circumference can be drawn individually from the database, which can be of use if a lid needs to be replaced. Furthermore, when used in conjunction with the digital photographs, organizations considering the lid replacement can save themselves an extra trip to the wellhead location.

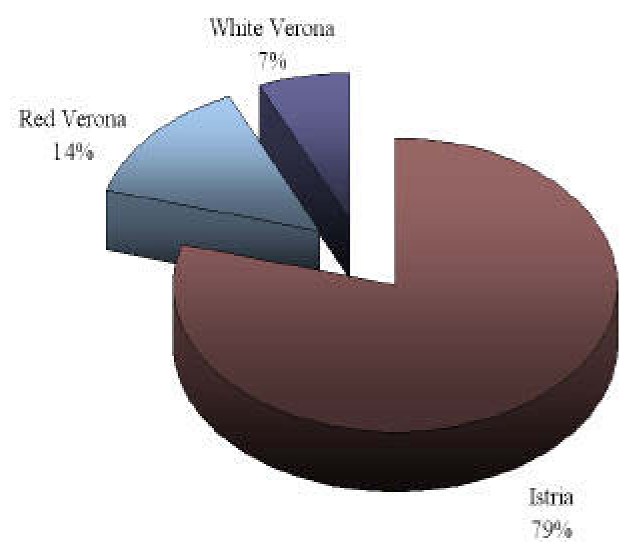

Figure 5-5 Platform Material

5.2.3 Wellhead Material

All but two of the 217 public wellheads cataloged are composed of exclusively Istria stone, Red Verona, or White Verona. As can be seen in Figure 5-6, Istria is the most commonly used material, as seventy-nine percent, or 172 of the wellheads cataloged are composed of this stone followed by a significantly less fourteen percent made from Red Verona, and seven percent White Verona. Displayed in Figure 5-6 is a graph and chart showing the varying wellhead compositions by individual *sestiere*. Two unique wellheads are not included since they were too minute to include in the pie chart, but need to be mentioned, as they are rare. The wellhead located in Piazzetta dei Leoni in San Marco is the only public wellhead that is composed of both Red Verona and Istria. In Corte Correra, there exists a wellhead made of Aurisina, which seems to be in excellent condition considering that it was built in or around the ninth century. This data suggests the possibility of attributing a certain measure of rarity according to material.

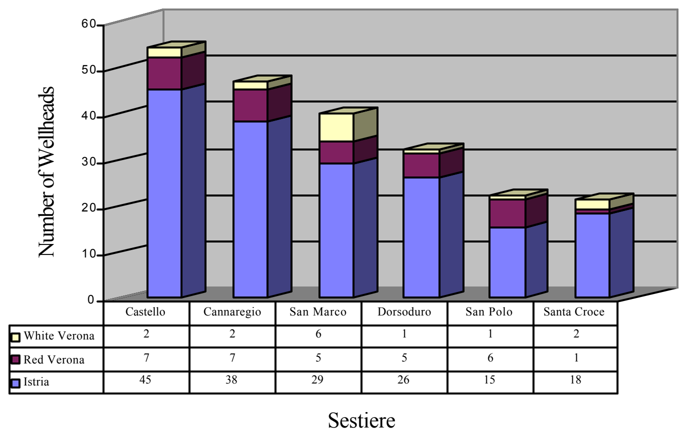

Figure 5-6 Wellhead Composition by Sestiere

We constructed Figure 5-7 by adding together the percentage coverage of specific damage types on every side assessment we recorded and dividing by the total number of equivalent type assessments. In this way, we created an average that gives a general impression of the state of each material on publi c wellheads. From this simple extraction, we can see that surface cracks are

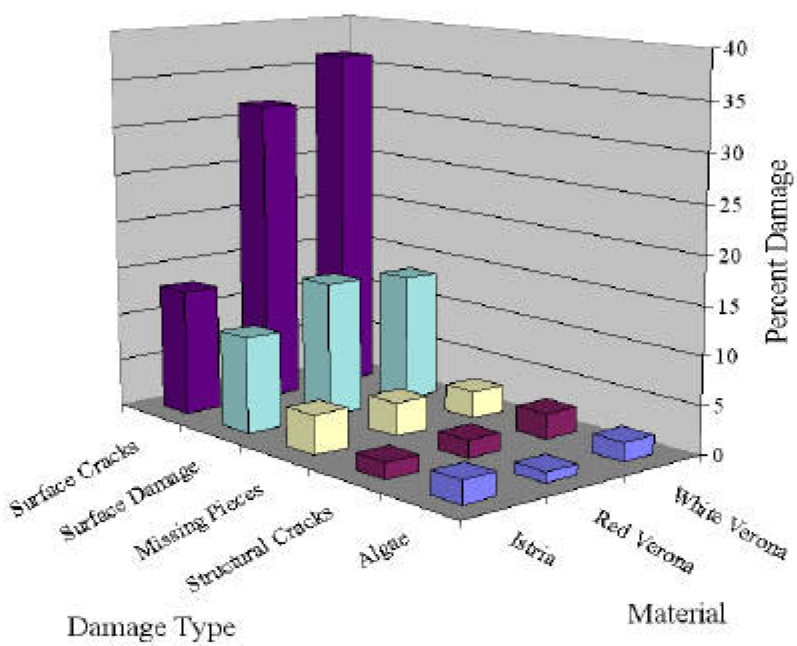

Figure 5-7 Deterioration by Material

certainly most prevalent in White and Red Verona. The coverage of surface damage is less on sides constructed from Istria, which may become important when taking into account the fact that the majority of the wellheads are made out of this material. Less obvious conclusions that can be made from the graph are that algae covers less of Red Verona than either White Verona or Istria, and White Verona was the least prone to missing pieces.

Figure 5-8 Istria Platform Repaired With Brick

5.2.4 Platform Material

The platforms cataloged were typically made of the same material as the wellhead itself with few exceptions. As pictured in Figure 5-8, Istria is the most common platform material. Aside from the seven percent without platforms, one percent had platform composed of materials other than Istria, Red Verona and White Verona. One wellhead located in Corte Rubbi had once been comprised completely of Istria at the time Alberto Rizzi cataloged it, prior to 1981, but was restored with bricks where extensive structural damage had existed. This particular wellhead platform is pictured in Figure 5-8. The other unique platform is made of concrete and located in Campiello De La Chiesa. It is unlikely that it is the original platform since concrete would not weather at the same rate as the wellhead above it which is made out of Istria. In fact, numerous platforms had been recently repaired or completely replaced, but we were not qualified to positively determine each such case, so this information was not included in the database.

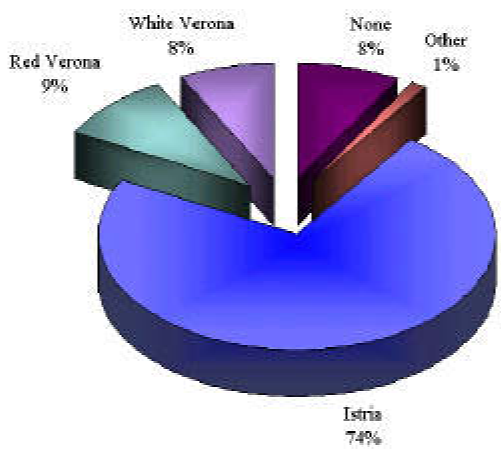

Figure 5-9 Platform Material

The platforms varied in shape but were generally circular or had the same number of sides as the wellhead resting on it. Most of them also contained water dishes that were filled for animals to drink from.

5.2.5 Lid Characteristics

A majority of wellhead lids were made of metal, with only one composed of wood. We classified the metal lids into two basic shape categories, flat or curved, to differentiate them in response to a specific problem associated with the flat design. Both shapes of metal lids would oxidize from moisture in the air and rainwater. However, the flat lids often had holes drilled through them for drainage where rust would severely eat away at the structure at a much faster rate than the rest of the lid. Even with the holes, flat lids tended to collect rainwater that would eat away at the surface in general.

Figure 5-10 Lids in Bad and Good Condition

We encountered many lids that had extensive rust-related damage (See Figure 5-10), including dangerous, jagged holes that can lead to cuts and infections, a particular threat to children we repeatedly observed climbing on the wellheads. Another problem associated with iron and iron-alloy lids is that the rust they produce also causes indirect damage to the wellheads through staining from rain run-off. If the lids were maintained or replaced on a need basis, the threat of tetanus and injuries could be minimized along with staining of the wellhead surfaces.

During our fieldwork we determined that wellheads should be considered a health risk if holes in the lid are large enough for a small child's hand to reach into. By using the photographs, we constructed a list of such lids and any others that appeared to require replacement. (See Appendix Q)

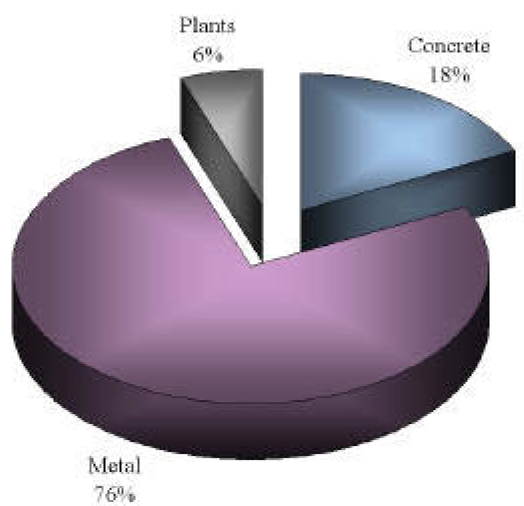

Figure 5-11 Lid Material

In cases where concrete was used to cap the wellheads, it often covered more than just the opening of the well shaft. Furthermore, concrete has a different coefficient of thermal expansion than most other types of stone. As such, when temperature changes cause the stone and concrete to expand, they expand at different rates and therefore cause cracking. This aspect of concrete as it pertains to restoration and in the construction of lids leads us to suggest replacement or at least removal of the concrete in favor of something else such as that mentioned in Appendix K.

Where plants were used to cap the wellheads, they deterred people from sitting on the tops, and added to the aesthetic value of the area in general.

5.2.6 Importance Factors

There are five true or false fields of data per wellhead that we attempted to use to quantify non - measurable data such as aesthetic worth and intangible value. They are: Public Visibility, Popularity, Historic Value, Artistic Value, and Rarity.

5.2.6.1 Public Visibility

Public visibility is a critical value in determining the importance of a piece, in the most superficial and easily recognizable sense. The weight of how often the wellhead is seen will help determine the necessity of the wellhead's preservation, in terms of contributing to city beautification, and amplify the necessity to address health concerns. As seen in Figure 5-12, twenty-seven percent of the wellheads in Venice are publicly visible and seventy -three percent are not. To determine whether the wellhead is visible mainly depends on the proximity to high -density tourist areas or if it exists on a main street between two points of interest. Publicly visible wellheads are typically easy to find and located in large campi as opposed to hidden in dead -end alleys.

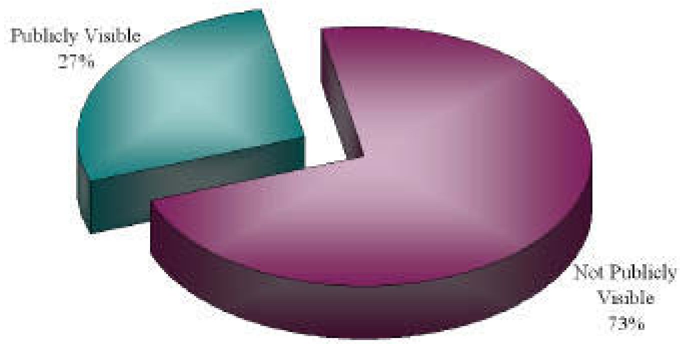

Figure 5-12 - Percentage of Publicly Visible Wellhe ads

5.2.6.2 Popularity

Popularity may be considered as dependent on public visibility in the respect that popularity attempts to record which wellheads were prone to large amounts of physical human contact. We assumed prior to beginning data collection, that this could be relatively easily assessed by considering it to be true if people other than ourselves came in contact with the wellhead during data collection. However, our presence at the wellhead most likely discouraged the approach of people passing by and therefore may only identify a few of the most popular cases. As Figure 5-13 illustrates, only 2% of the total public wellheads can be considered as popular.

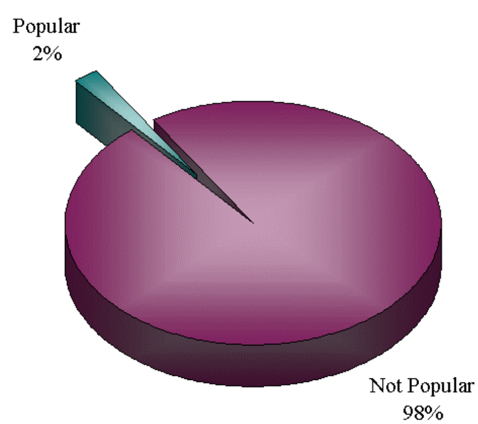

Figure 5-13 Percentage of Popular Wellheads

5.2.6.3 Historic Value

Age contributes to the value of art. For our purposes, differentiating wellheads by centuries was not necessary since we wanted to single out a small number of the wellheads in relation to the whole. We determined the presence of historic value by referring to the approximated dates of construction as compiled in *Vere da Pozzo di Venezia* and adding to the classification, all public wellheads built before 1300 AD. For this reason, we decided to use a true or false field instead of a numerically weighted date approximation in terms of attributing each wellhead with a value that would place it in a linear distribution with the rest of the values.

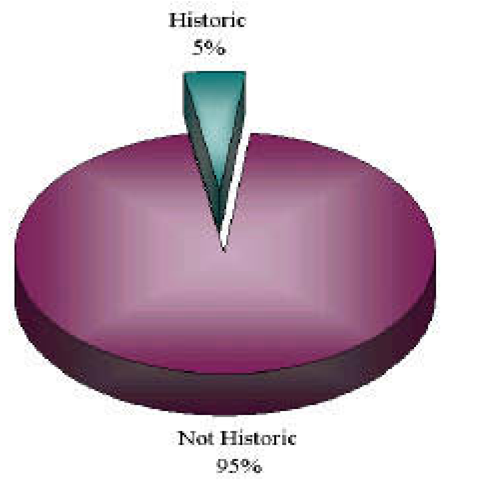

Figure 5-14 Percentage of Historic Wellheads

We attempted to focus on the time period before Venice lost half of its population to the Black Death in 1348 AD [41] when Venice was still organizing itself as a Republic. Only five percent of the public wellheads are from before this major event in Venice's history, but depending on individual preference, one could logically select any event of interest and justify it as a turning point. The significance of this result is not to define what is historic, but to create a division between what does and does not need to be recognized in terms of age.

5.2.6.4 Artistic Importance

Simply put, if we determined a wellhead to be aesthetically pleasing, we marked it as having artistic importance. In particular, our team looked for detailed carvings, elegance of design, and whether or not it had a generally pleasing impact on us. In addition, wellheads that had suffered from extensive deterioration seemed to lack aesthetic luster in comparison to similar designs, which would suggest that the factor might in fact be redundant of state of conservation data. However,

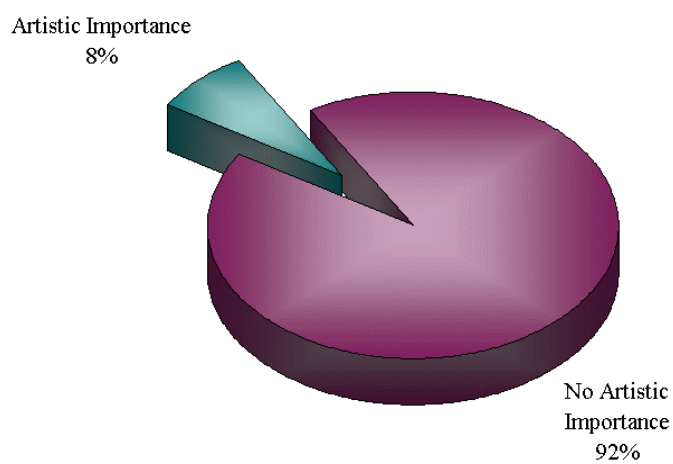

Figure 5-15 Percentage of Wellhead with Artistic Importance

[41] Knopf Guide: Venice, Italy. Alfred A. Knopf, Inc., New York. 1993. pp 31

we felt that the redundancy actually worked in favor of better qualifying artistic importance.

As shown by Figure 5-15, we considered eight percent of the wellheads to have artistic importance. Although the datab ase registers ninety-two percent as having no artistic importance, one must keep in mind that they do not literally lack any aesthetic value, but have been separated from the examples that were more impressive.

5.2.6.5 Rarity

Rarity of a wellhead was dependent on the existence of desirable features or historical significance that set it drastically apart from other public wellheads. Twelve wellheads were determined to require the rarity flag as listed within Figure 5-16, which also describes their area locations and reason we classified them as rare. As with more of the importance factors, a large part of determining qualification was based on the opinion of the project team.

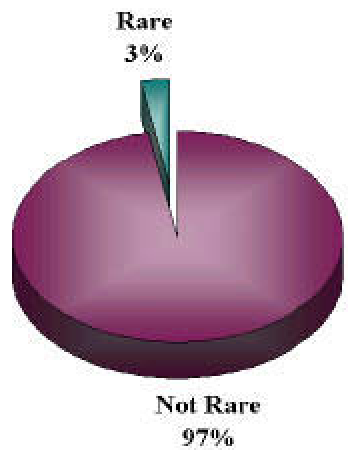

Figure 5-16 Percent Rare

Wellheads that made a particularly lasting impression on us in terms of their unique design such as a two -material wellhead previously mentioned and another, which took structural curves to a noticeably extreme level. One wellhead had been intentionally built into a wall to allow half of the wellhead to be private. Wellheads that featured lions were particularly rare after the Napoleonic occupation. Two other wellheads featured original metal frameworks used to support the pulley system that allowed easier water retrieval. A single wellhead stood out as being in noticeably excellent condition and had once been private, and three were relat ively cubic in shape.

RIZZI #	LOCATION	REASONS FOR RARITY
1	Piazzetta dei Leoni	Unique design
145	Calle Del Pestrin, Gia Campiello Del Galeto	Unique design
226	Corte De l' Aseo	Half public and half private
16	Campo S. Fanti n	Lions
76	Campo S. Filippo E Giacomo	Lions
116	Campo S. Marcuola	Lions
152	Campo S. Giovanni Grisostomo	Lions
21	Corte Dei do Pozzi	Original metal framework
22	Corte Dei do Pozzi	Original metal framework
164	Corte Petriana	Once private, in excellent condition
74	Campiello Del Piovan	Square
84	Corte Correra	Square; rare material
148	Campiello Del Remer	Square

Table 5-1 Wellheads Considered Rare

5.2.7 Other Information

Some of the other information we recorded includes the existence of metal accessories, illegibility, previous restoration, and the number of drains. After weeks of data collection, our project team came to new conclusions about the nature of some of the distinctive features and their importance to the wellhead preservation effort.

5.2.7.1 Metal Accessories and Rust

Metal accessories are a commonly found feature on public Venetian wellheads. They vary in type such as waterspouts, hooks, and handles, many of which were added long after the wellhead was built. Waterspouts are more recent additions that were installed after the wellheads were made obsolete by the aqueduct. Most other accessories are left from the time when the wells were still used for drawing water. There are metal hooks and arms that were used to help hoist buckets of water. A few wellheads even have metal frames with pulleys to ease the chore of raising a bucket. These features add to the character of each wellhead and remain as tangible artifacts of ancient Venice. We kept track of the existence of metal accessories in the basic information sub-section of the database, as well as recorded a brief note to the effect of what the accessory looked like or function it served.

Conversely, metal accessories also cause an assortment of problems. Many metal accessories produce rust on the stone from rain run-off and on the accessories themselves. Other problems include the holes left behind when the accessories are removed and the inadvertent surface and structural damage that can be caused by pulling on loose bolts and moving parts. Since rust usually accumulates on the wellhead following the flow of rainwater from where the rust originates, we deemed it unnecessary to collect directionally specific data. If rust existed anywhere on the wellhead we marked the field as true.

5.2.7.2 Illegibility

Similar to the analysis of the features on the wellheads, it was important to note the illegibility of inscriptions. The simple inscriptions are usually the first to disappear from the wellheads, as the cuts were not made as deep into the stone as carvings. This made them more susceptible to weathering and deterioration. Most of the inscriptions give dates of construction or restoration, and sometimes even include the names of donors, churches, families, or a group directly involved with the wellhead. See Figure 5-17 for an example of a partially illegible inscription.

Figure 5-17 Partially Illegible Inscription

We found that forty-four wellheads had inscriptions and thirty-six (eighty-one percent) of those wellheads had some level of illegibility. However, it is important to preserve even the slightly deteriorated inscriptions regardless of their current state, as they are messages sent from the past, written in stone, but not necessarily forever.

5.2.7.3 Previous Restoration

The lack of previous restoration of a wellhead may mean that it has been overlooked in the past and requires attention. For this reason it was important to include this piece of information in our catalog. It was also important when determining the am ount of interest that the Venetian government has towards maintaining the wellheads.

Fifty-nine percent of the wellheads cataloged had some level of previous restoration, but this does not mean that these wellheads no longer need maintenance. Even the re storation material deteriorates, often at a rate equal or faster than that of the rest of the structure. Our team did not have the time or resources to fully explore this avenue of interest.

5.2.7.4 Number of Drains

Figure 5-18 displays the density of the number of drains per wellhead. Recording the number of wellhead drains serves to keep a record of another part of the original structure. We can assume that originally, every wellhead had at least one drain to allow water into the cistern. However, since a record of the number of original drains did not exist prior to the completion of our field work, there is no way to accurately tell how many drains have been destroyed or removed up until now. Future research teams have the benefit of referring to the data we collected to determine the number of drains lost from this point forward.

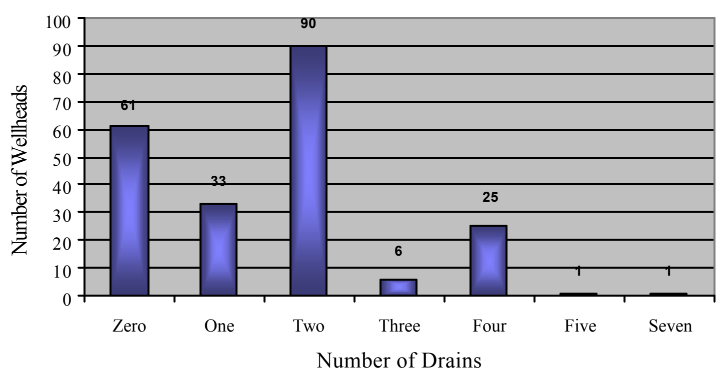

Figure 5-18 Number of Drains

5.3 Side Information

Another subsection of the wellhead databas e contained relevant information on the sides of each wellhead. This includes the angle from north, the amount of deterioration in each of the eight categories defined by our project team, and any relevant notes about the side including whether it had rop e marks, a carving, or an inscription for each of the 1168 sides we cataloged.

5.3.1 Assessment of Sides

The sides were all analyzed based on their angle from north. If the angle was between 315 and 45 degrees it was considered to be north, between 45 and 135 degrees was considered east, between 135 and 225 degrees was considered south, and between 225 and 315 degrees was considered west. This separation allowed us to determine if a particular type of deterioration was concentrated on one particular direction and aided us in determining the amount of wellheads that were in severe need of restoration.

Figure 5-19 shows the percentage of graffiti by *sestiere*, which was originally recorded in hopes of providing the police with specific information regarding various tags. However, after cataloging more than half of the public wellheads without confirmation of a single repeating tag, our team realized that the potential to provide any useful information about vandalism to the wellheads was not likely. The information gathered does however show that Sa n Polo had the largest percentage of vandalized sides, while Dorsoduro had the least.

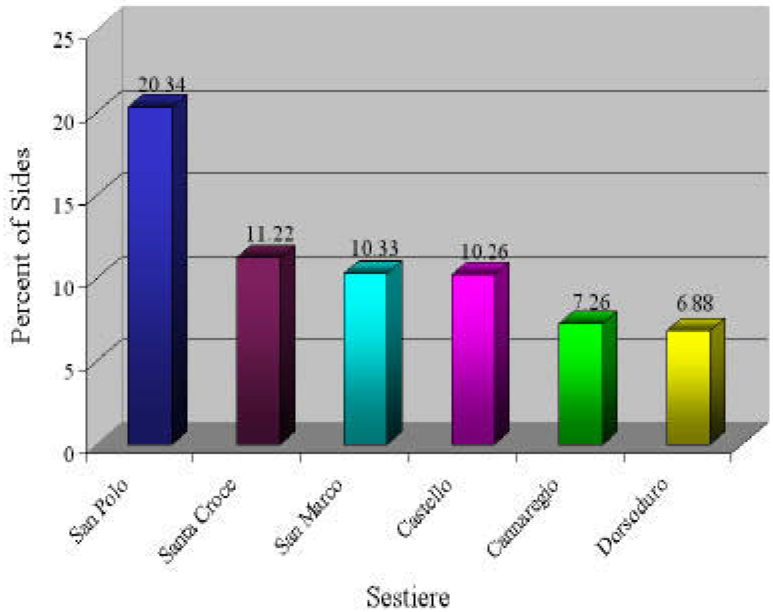

Figure 5-19 Percentage of Sides with Graffiti

As can be seen in Figure 5-20, a large amount of difference did not occur between directions, however, surface cracks mainly occurred on the north and west sides of the wellhead, while surface damage was mainly concentrated on the north side. Light grime and heavy grime were not found in large amounts on the south side, but were located

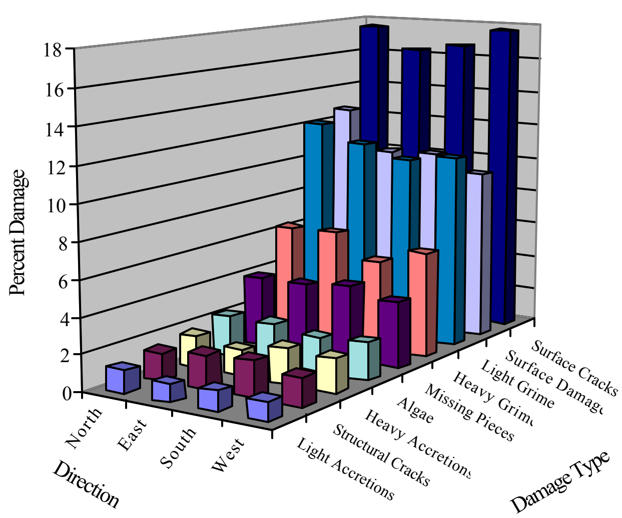

Figure 5-20 Damage Assessment

on the north side the most. Missing pieces were most common on the south side of the wellhead along with structural cracks, while algae, heavy accretions and light accretions were very similar on all four sides.

5.3.2 Side Features

Along with cataloging the deterioration of each side, we also took note s about any image, inscription, water dish, or rope mark. The figures on any particular wellhead usually give information on the wellhead itself. Where inscriptions can give a written indication to the time period in which the wellhead was constructed, shields or crests can give information about the family that provided the funds for the wellhead to be constructed.

As can be seen in Figure 5-21, shields were the most common figure on the sides of the public wellheads, even though water pitchers were used to indicate that a particular well was intended for public use. Religious figures and crosses usually served as an indication to the whereabouts of the nearest church by being located on the side of the wellhead that pointed in the churches general direction. It is interesting to note that a majority of the wellheads originally contained images of lions on the side as a symbol of the republic. Most of these lions were removed by order of Napoleon upon his acquisition of Venice. These lions account for a large amount of missing items on wellheads and today there are only four public Venetian wellheads featuring lions.

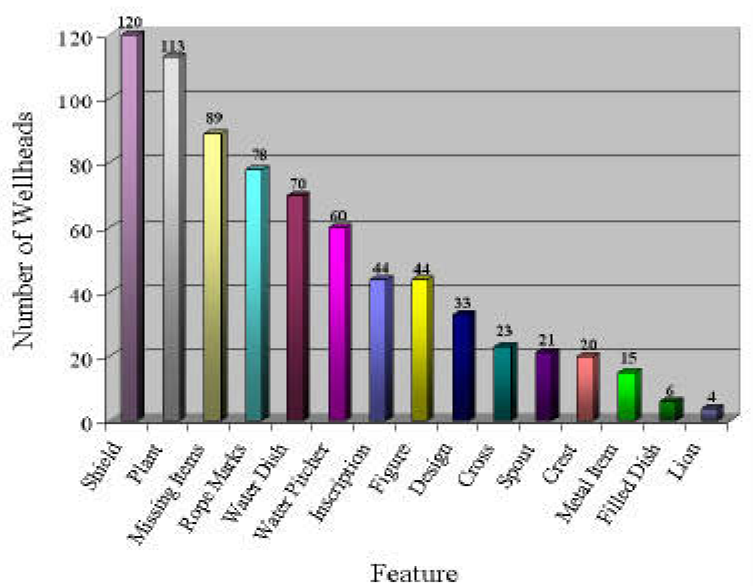

Figure 5-21 Side Features

5.4 Corner Information

The third database sub-section contains all of the information pertaining to the corners of each wellhead. All of the corners were cataloged in the same manner as the sides, which allowed for a similar evaluation of the corners. Combining the information located in these two database sub -sections allowed us to complete our restoration prioritization algorithm.

5.4.1 Corner Deterioration

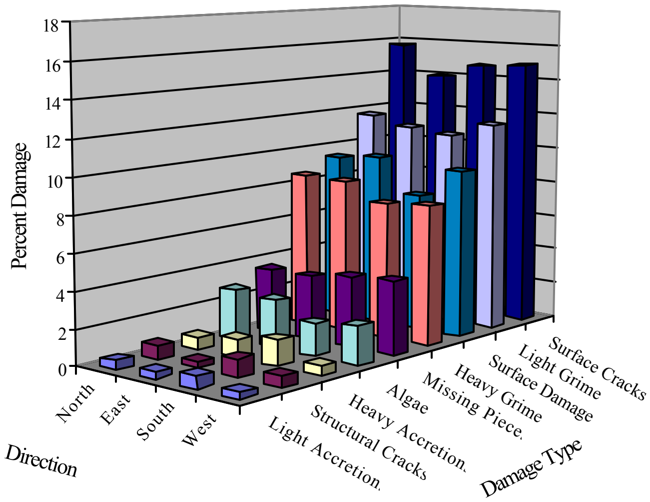

Figure 5-22 Corner Damage Assessment

As can be seen in Figure 5-22, surface cracks were more prominent on the north most corners and least prominent on the east most corners. Almost the opposite is true for structural cracks, which appear mostly on the south corner and least prominent aga in on the east corner. Both light and heavy grime followed the same pattern with the largest percentage on the north corner, the east and west corners being about equal and the south corner having the smallest amount of grime. Surface damage and missing pieces follow a more uniform pattern within themselves with a minor exception in surface damage on the southernmost corner of the wellhead being a smaller average that that in the other three directions. Algae are more prominent on the northeast and west corners than on the south corner. Heavy and light accretions followed a similar pattern even though they are random occurrences. The majority of the accretions occurred on the southernmost corner and the minority of the accretions occurred on the west co rner.

5.4.2 Corner Features

Similar to cataloging additional data on the sides, we did the same for corners of wellheads. Although many corners were plain geometric designs, we found there to be 128 corners, which had some form of a leaf on them, as can be seen in Figure 5-23. Often the leaf would be large and elaborate, located in the upper portion of the corner, but there were also corners, which had a

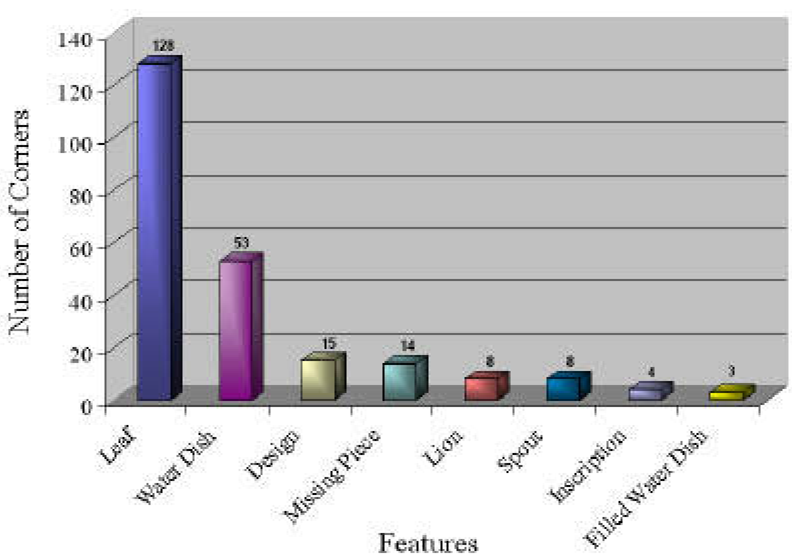

Figure 5-23 Corner Features

plain fern-like leaf on all eight corners.

Large portions of the water dishes were located on the corners of the platform as opposed to the sides. Several platforms even had more than one water dish, with some having a water dish on each corner.

Carvings, designs, and inscriptions were clearly more prominent on the sides of the wellheads, which can be seen with a simple comparison between Figure 5-21 and Figure 5-23. This can easily be attributed to the fact that the area of the side is bigger than the area of the corner and leaves more room for artistic freedom.

5.5 Consumption of Human Features

In recording information on the public wellheads, we confirmed the existence of 27 wellheads that featured 57 carvings of decidedly human figures. In comparison to most other carvings on wellheads and public art in general, the human form is often the most elaborate and detailed in design and therefore at the greatest risk of deterioration. We identified these wellheads and separated the relevant information into a sub-section of the database dedicated to archiving the characteristics and state of conservation of human figures by body part (See Appendix B).

We dismissed the idea of including the existence of human figures in the prioritization algorithm for two major reasons. Although the existence of a human figure would suggest that the figure would deteriorate faster than the rest of the wellheads surface, extensive surface cracking could simulate the same surface conditions as far as deteriorating factors are concerned. In addition, the deterioration to a human figure was usually included in the overall damage assessment in terms of surface damage, missing pieces and artistic value.

Considering this, we conducted a secondary prioritization solely among wellheads that displayed human figures. We simply translated the good, going, gone scale into a 1, 2, 3 scale, respectively, and added values together to get a state of conservation score for all human figures on a wellhead. A higher score suggests worse deterioration and thereby allows preservationists to focus on these wellheads separately in order of their deterioration severity.

Another perfectly valid method of executing this would be to treat "gone" as a zero, thereby passing over pieces that are beyond help. See Figure 5-24 for a contrast between what should be focused on during restoration planning (left) and what should probably be passed over (right). The results of these rankings are located in Appendix R.

Figure 5-24 "Good" versus "Gone"

5.6 Improper Use of Wellheads

Originally, we had intended to use the Improper Use database to record graffiti and using MapInfo, deduce the general area in which certain tags appeared. This would have been done to aid police in catching vandals by determining their preferred territory. However, the examples of graffiti that we found did not repeat enough to perform such an analysis and consequently, we used this database to only document improper uses including the existence of graffiti and possible threats in the immediate environment of the wellheads. We also observed that the graffiti was often written in languages other than Italian and was dated, which suggests that visiting tourists may be a main source of the graffiti on the wellheads.

We classified use of the wellheads as serving tables and inclusion in dining area arrangements as an improper use regardless of the actual threat restaurants pose. We focused on the cultural impact of covering a piece of art in a tablecloth and flower arrangement See Figure 5-25 for an example of a wellhead located in a restaurant (Rizzi #9). However, it is important to note that wellheads in such locations are likely the least prone to damage from weathering since awnings and other co verings, that serve to protect patrons from inclement weather, also protect wellheads.

Figure 5-25 Example of Improper Use

5.7 Rizzi Information

Alberto Rizzi collected a great deal of information on wellheads that we found useful and would normally have been inaccessible. Aside from measurements of wellhead dimensions, we could not reproduce much of his collected data. In particular, information on the approximated building dates of individual wellheads was useful to us in determining the distribution of wellheads by date as illustrated by Figure

Figure 5-26 Wellheads by Approximate Date of Construction

5-26. A more detailed comparison can be seen in Appendix S.

By separating the points onto different maps, we can get an idea of how public wellheads spread throughout the city over time. The results of this can give one a better idea of how closely the original building of the wellheads was tied to city planning.

5.8 Special Details

We entered any interesting feature of the wellheads that we observed into the Special Details sub-section of the database in the form of general notes. This information would not be particularly useful in prioritizing the wellheads, nor in determining anything particularly interesting about the nature of deterioration. However, it does serve to complete the record of a wellhead's characteristics in a sense that the database has extensive information to differentiate one wellhead from another in more than just a Rizzi number.

5.9 Summary

Throughout this chapter we took a close look at the information we collected in many different forms and formats, but to truly utilize the full possibilities would require more data collection and much more time. Considering that time constraints may be the largest obstacle to the advancement of knowledge, we intended to use the information to ignite further research by focusing on the possibilities for further study and customized use of the data.

In the next chapter, we will go into further detail and depth of determining some of the most compelling results we identified, and their usefulness for more than just researchers.

Chapter 6 - Analysis

We had two main objectives in analyzing the data: to provide information on the nature of wellhead deterioration and to help guide future restoration planning. In order to qualify our findings, we use repeated statistical testing in the form of linear regression analysis and the calculation of projected percentage error.

The first portion of thi s chapter deals with checking our collected data for consistency, in preparation for a ranking of public Venetian wellheads. This is done in terms of state of conservation and importance factors to guide restoration and preservation efforts in identifying wellheads most in need of attention.

We will then analyze the deterioration facing all public wellheads, focusing on the identification of directionally dependent sources and the extent of deterioration grouped by wellhead material. Recognizing a correlation between a type of damage and its source may be the first step to unearthing the causes of specific types of deterioration.

6.1 Confirming Consistency

The first obstacle we encountered in comparing wellheads was trying to establish fairness and consistency among non-definite data sets throughout the fieldwork process. Direct dimensional measurements and true or false database fields were determined to be consistent from a relatively quick comprehensive reassessment using the photographs after fieldwork wa s completed.

We needed to ascertain that the state of conservation assessments were in fact genuine and consistent. Specifically, in the identification of a possible measurement bias, typically associated with collecting extensive amounts of conditional data. We realized that during fieldwork, even with constant reviews of the current process, against the outputs created from earlier in the study, the information collected could fall victim to a bias associated with gaining field experience. As we were exposed to more types and severities of damage the assessments could correct for overestimations made in the beginning of the study. In theory, this phenomenon would appear as a negatively sloped linear association in a scatter plot sorted by the severity of assessments over time.

6.1.1 Testing the Data

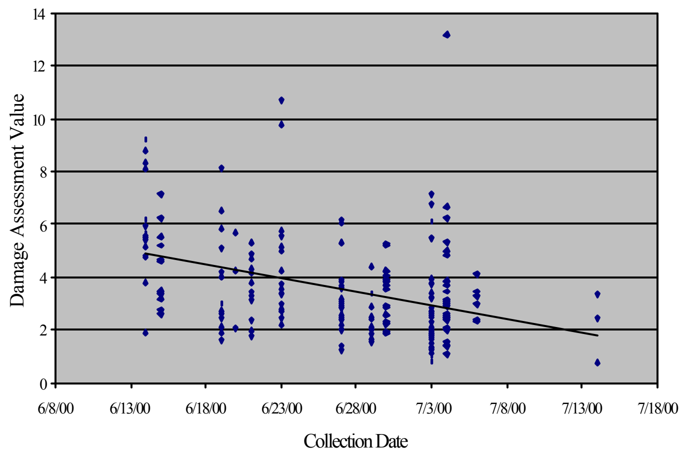

Figure 6-1 Damage Assessment Values over Time

To test this hypothesis, we plotted the averaged coverage per sides and corners of each wellhead by the order in whi ch the assessments were made. The result of this plot is illustrated by Figure 6-1. We observed that there was in fact an implied association by matching a linear regressor to the data and confirming the presence of a negative slope. However, pure association alone cannot imply cause and effect.

As we considered the implications of this discovery, and after brief discussion with colleagues and advisors we came to the conclusion that we would not actually be able to determine a c onclusive mathematical cause and effect relationship without performing the entire study over again in reverse order. There was a remote possibility that our constant review of assessment methods were inadequate in staving off measurement bias, or perhaps the steady decrease in bright sunlight over the course of the study served to conceal more damage. The most likely hypothesis was the fact that we began data collection in San Marco, which is a high -traffic tourist area and continued fieldwork into less populated areas. People likely have a direct effect on the deterioration through contact, but we did not focus our study on identifying the extent of this threat.

6.1.2 Conclusive Lack of Statistical Proof

Essentially, there were too many factors to consider in determining whether or not the association was an actual measurement bias and therefore the only way left to check was to review as many of the earlier assessments as possible against the photographs. After a few hours of this, we decided that the data was in fact genuine.

6.2 Restoration Prioritization Algorithm

We did not build a catalog of all public Venetian wellheads to solely create a resource, but also a tool that can assist in preservation efforts. To accomplish this goal, we begin to tap the use fulness of the collected data by offering a simple and effective way by which to plan restoration schedules. By maintaining simplicity in the form of the algorithm, it allows reproduction and customization of the process with minimal effort. Furthermore, we maintain that simplicity does not sacrifice relevance of the results, through a series of logical proofs and statistical analyses. We built this algorithm to emphasize the importance of restoration of certain wellheads. We feel that the wellheads at the top of our list need to be restored immediately before they become completely irreparable.

Wellheads, and all outdoor public art, needs to be restored at least once every five years in order to avoid exponential decay. We believe that the wellheads at the top of the list are most in need of frequent restoration, and the wellheads at the bottom of the list should be restored at least every five years, but can wait longer if there is a limited amount of finances for restoration. Any restoration done after the initial restoration will mostly involve cleaning, will cost much less, and will benefit the wellhead greatly.

6.2.1 Determining Relevant Factors

From our fieldwork and background research, we had access to a wealth of information on the wellheads. It is possible to include nearly every database field in prioritizing the wellheads, including over 30,000 entries, and justify its relevance through weightings and multipliers. This is not necessary as we affirm that the two major areas of interest when placing the wellheads in order of restoration urgency are state of conservation data and importance factors. By limiting the number of contributing fields, we address the realistic aspect of keeping it manageable and usable.

6.2.2 State of Conservation

We consider the most important information by which to judge the restoration attention urgency to be state of conservation assessments. Very simply, more coverage of the negative forms of deterioration leads to a worse condition of the wellhead, and consequently, the higher the priority in terms of restoration. We used the nine types of deterioration mentioned throughout this project and reiterated here in Table 6-1.

Damage Assessment	
Accretions2	Paint accumulations usually caused by graffiti that obscures the surface of the wellhead completely
Accretions1	Paint accumulations that are sporadic as in the edge of spray paint marks or tiny spattering that still allows the wellhead surface to be seen within it
StructuralCracks	Any cracks which are deep into, or all of the way through the wellhead wall; potentially causing severe structural damage
SurfaceCracks	Minor cracks located on the outermost surface of the wall
Grime2	Grime, dirt, and sulfur accumulations that are pervasive to the point of completely obscuring the wellhead in coverage
Grime1	Grime, dirt, and sulfur accumulations that are light enough to still see the stone surface
SurfaceDamage2	Heavy damage to the surface; includes missing pieces
Surface Damage1	Light damage to the surface; includes pitting, chalking and flaking
Algae	Biological plant growth which slowly digests the stone and/or widens microscopic cracks causing damage

Table 6-1 Definitions for Damage Assessment

As mentioned earlier in our methodology, previously restored damage was not counted toward the coverage. We were more interested in quantifying damage to the wellhead, whereas determining the nature and rate of restoration deterioration could be a project within itself. We can be relatively certain that the restoration will deteriorate at a rate faster than the wellhead, but determining how much faster would require some sort of study over time. (See Chapter 7 - Recommendations)

6.2.2.1 Conceptual Model

The basic idea behind creating a score that accurately reflects the severity of damage, as well as the risk of current deterioration, is first determining the total coverage of the damage and accumulations, then assigning them weights to make more important factors count for more in the final comparison. This equation for the deterioration assessment (S_{DA}) can be essentially represented mathematically as follows:

$$S_{DA} = \sum\left[\sum \frac{D}{s}(W_{DA})\right](W_{ODA}) \qquad (6.1)$$

D	**The percentage of each type of deterioration on a side or corner of the wellhead**
s	**Number of surfaces**
W_{DA}	**Weighting value for each individual damage assessment factor**
W_{ODA}	**Weighting value for the sum of the damage assessment factors**

6.2.2.2 Weighting

The actual process we used to determine individual weightings for types of deterioration was not very scientific, however, we reaffirm that simplicity in design is what qualifies this analysis as useful. The first thing we did was rank the damages by three major criteria:

1. Risk to Structural Integrity
2. Aesthetic Detraction
3. Projected Increase of Risk in the Future

We accomplished this through discussion among our team and input from our advisors, however, such extensive research in the field of deterioration is not actually necessary. For users of this algorithm, the level of involvement will not affect the result to an extreme that could not be corrected from review of the photographs. Keeping the weightings constrained to a sum of no more than 100% also simplifies the process in the sense that it allows the user to visualize the distribution of weights realistically.

For example, if one were interested in Structura l Cracks since they seem to turn into Missing Pieces and larger Structural Cracks in time, the user could give it 90% of the weighting and the worst that could happen would be that other deterioration types would fall by the wayside in comparison, but stil l be ranked relatively well among each other. In essence, you get what you ask for.

The weighting distribution that we selected is illustrated by Figure 6-2. We were most interested in giving structural cracks and missing pieces (SurfaceDamage2) the highest priority since they represented literal loss of wellhead material. We followed with heavy paint coverage (Accretions2) since it severely detracted from the aesthetic impact of the wellheads. Next, we placed a lgae since it suggests the presence of water, which is key to practically every type of deterioration. The latter values were not quite as important as the former, but nonetheless representative of each wellhead's state of conservation.

6.2.2.3 Result of Analysis

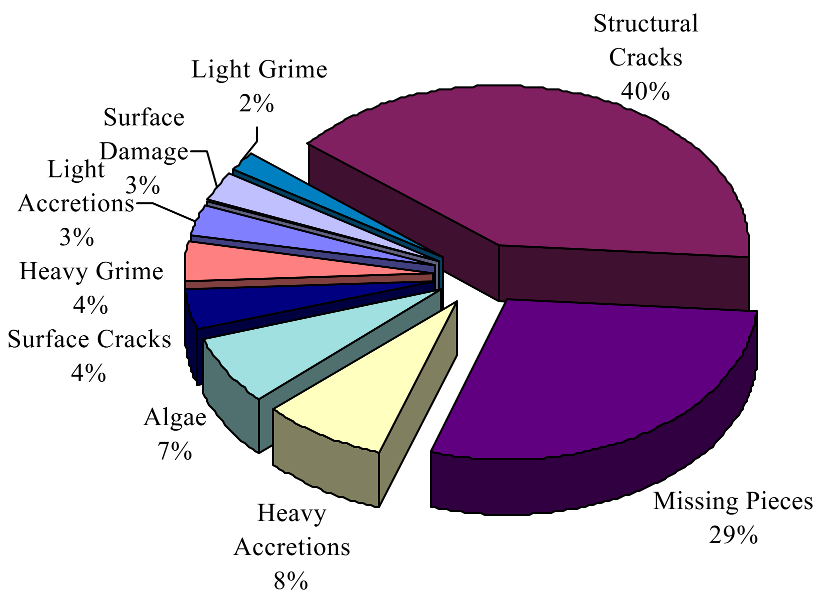

Figure 6-2 Deterioration Factor Weight Values

By using equation 6.1 to calculate the factor contribution to the total prioritization for each individual wellhead, we were able to rank them purely from damage assessment. The complete result of this ranking is included in Appendix T

6.2.2.4 Confirming Prio ritization

Considering that not many people have seen and scrutinized every public Venetian wellhead, we were confident that our final judgment of the data would be fair. To correct doubts before implementing more factors to the overall algorithm, one may use the photographs to confirm that the values are acceptable by checking the best and worst rated wellheads. At this point, the results of the ranking could be used as is, and would give an excellent recommendation as to where to focus restoration effor ts to fix the wellheads in the worst condition.

6.2.3 Importance Factors

Each importance factor was a valuable piece of information when determining the deterioration prioritization list. Any wellhead with a level of importance would be ranked higher than tho se without, because they are more significant to Venice than the others.

The contribution toward the individual wellhead scores were calculated simply by treating each true as a 1 and each false as a 0, then multiplying by a weighting factor determined by the logical significance of each importance factor.

6.2.3.1 Weighting

Once again, our project team determined weighting based on experiences during fieldwork and recommendations by our project advisors. The weightings were determined as follows:

- Public Visibilit y 25%
- Popularity 25%
- Rarity 20%
- Historical Significance 15%
- Artistic Significance 15%

Multiplying the 1's and 0's by the weightings generated a density of importance factor contribution as described by Figure 6-3. The histogram suggests that the bulk of the distribution has a low importance factor contribution and therefore may require more factors to differentiate the values in future studies. However, for our purposes of sorting them in a general fashion, these should suffice.

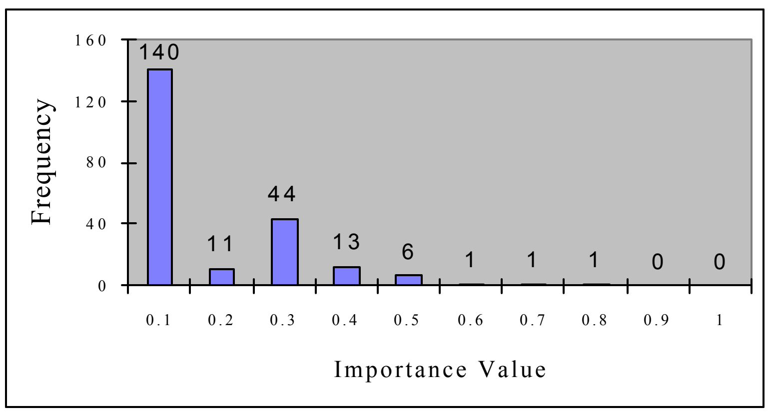

Figure 6-3 Histogram of Importance Factor Scores

6.2.4 Result of Final Analysis

By summing the weighted factor contributions from both the state of conservation analysis and the importance factors, we created an effective sorting of the wellheads by urgency of restoration attention. Equation (6.2) is the complete algorithm, which is broken down into its constituents in Appendix H.

$$RAU = S_{DA}\left(W_{ODA}\right) + S_{IF}\left(W_{OIF}\right) \qquad (6.2)$$

The final contribution scores are weighted based on the mean value contribution score originally found for the state of conservation. Literally, by using the mean value of S_{DA} as the weighting for S_{IF}:

$$W_{ODA} = 10 - W_{OIF} \qquad (6.3)$$

$$W_{OIF} = \frac{\sum\left[\sum \frac{D}{s}\left(W_{DA}\right)\right]}{n} \qquad (6.4)$$

The effect of the importance factors on the previously calculated state of conservation is described graphically in Appendix U. If a greater weight on importance factors is desired, a forced value can be used for the W_{OIF} and W_{ODA} instead of the F_{DA} mean. The only reason we used the mean was to keep the importance factors automatically scaled low. This was arbitrary, but seemed appropriate since it kept the importance factor from doing much more than "breaking -ties" where two rankings were close.

6.2.5 Confirming Prioritization

Once again, the finalized ranking was checked against the photographs and we felt satisfied that the results were useful. The five wellheads most in need of restoration can be seen in Figure 6-5. Placing

Figure 6-4 Five worst wellheads in prioritization list

217 wellheads in order of damage would have been nearly impossible to do without the aid of a computer, the numerically quantified data we collected, and the use of Microsoft Office Suite. It is also important to note that making progress on the prioritization would have been much more difficult without the previous work of the 1995 WPI Wellhead and 1995 Dorsoduro Public Art project teams. The final prioritization list can be found in Appe ndix J.

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6.2.6 Using the Prioritization List

Although this list could be used as is, we would encourage that it be customized toward the user in terms of personal preference and priorities. In addition, it is not meant to serve as a literal queue to follow blindly through restoration. As with most references, it is only meant to act as a guide to help organize in the face of an overwhelming number of variables. We realize that restoration takes time, but regular cleaning, at least once every five years, would de crease the problem of exponential decay and irreversible damage.[42] Unfortunately, with 217 remaining public wellheads there is not enough financing for all of them to be restored that frequently considering the cost estimates we found in researching backgr ound information.

6.2.7 Cost Analysis

In order to halt all further exponential decay, assuming that each wellhead was restored once every five years, (217 wellheads total) wellheads would have to be restored at a rate of approximately one per week. This could co st the city anywhere between 528 million ($264,000) and 880 million ($440,000) Lire per year. Although a new wellhead would cost roughly 30 million Lire as created by stonemasons that specialize in replicating art in Venice, it does not preserve the cultur e and historical meaning that cannot be replicated.

6.3 General Damage by Material

Based on the prioritization by state of conservation, we speculated that there were probably patterns within the data such as the distribution of wellheads by material. From a previously created chart located in Chapter 4, we had determined an implied correlation between types of damage and the material type. In order to get an idea of total damage coverage for individual materials, we separated the materials within the ranking graphically in Figure 6-5. From the plot, little can be discerned as really standing out in terms of distribution even considering the weightings.

[42] Fund -Raising Tips, Tales and Testimonies- Private-Public Partnerships to Save Outdoor Sculpture. ©1994. National Institute for the Conservation of Cultural Property.

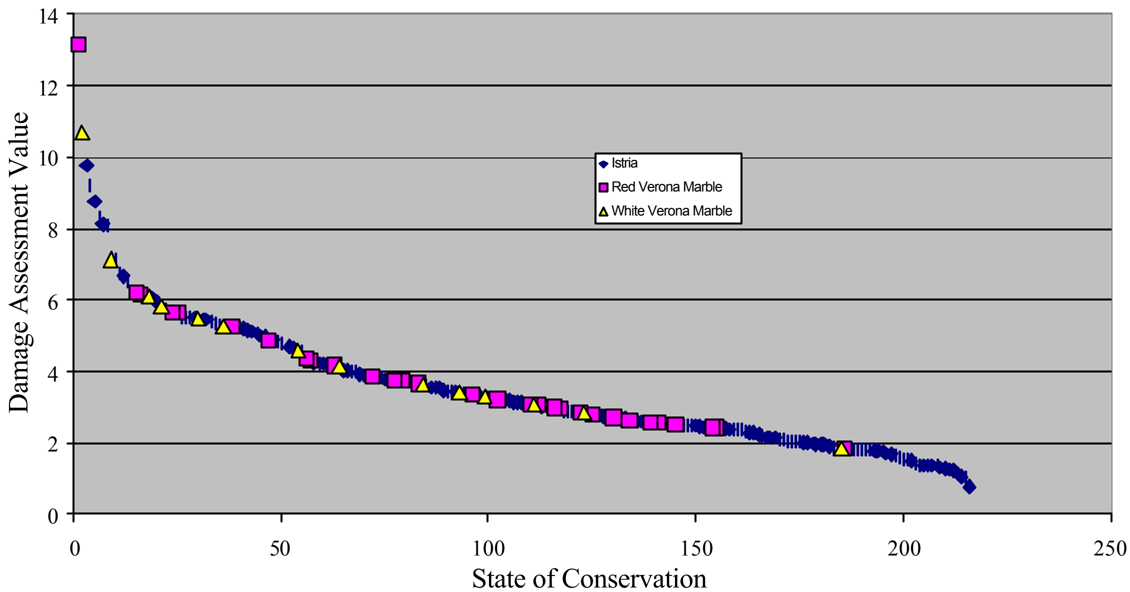

Figure 6-5 Material Analysis of Damage Assessment Values

We can conclude that from our particular study and weighting system, classifying all damage of the wellheads is not specifically more severe by material type as far as coordinating resto ration plans should be concerned.

6.4 Directional Damage Analysis

In order to take another step towards understanding the plight of Venetian wellheads as well as outdoor public art in general, we performed an analysis on the distribution of damage around the e xterior surfaces, divided into compass directions. The most important conclusions that can be made from this analysis would be to focus further research efforts in determining unconfirmed threats that may systematically and consistently damage all surface s in the city. Subsequent studies may lead to forming definitive defense strategies and focus restoration efforts to an even higher degree.

6.4.1 Determining Number of Directions

As mentioned in previous chapters, we had collected state of conservation data alo ng with the angle of each individual side and corner. These side and corner entries amounted to 1,684 points of data per damage type for 217 wellheads, each attributed with a direction in terms of degrees clockwise from magnetic north. The most logical m ethods of dividing the directions to judge by were in one of three different configurations:

- **4 directions** – North, East, South, West
- **8 directions** – North, Northeast, East, Southeast, South, Southwest, West, Northwest

- **16 directions** - North, North-northeast, Northeast, East-northeast, East, East-Southeast, Southeast, South-Southeast, South, South-Southwest, Southwest, West-Southwest, West, Northwest, North -Northwest

Dividing the number of data points by the number of wellheads gave us an average number of 7.760 directionally relevant data points per wellhead. Since the closest number to one of the aforementioned division of sides is eight, this would provide the most realistic result in terms of accurately representing real data. We can conclude logically that at least 3% of the data will become unusable since there is not enough information to fill all the fields evenly. This can be proved mathematically simply by using a standard error estimate to approximate the discrepancy where:

$$\%Error = \frac{Observed - Actual}{Actual}(100) \tag{6.5}$$

By treating eight as the "actual value," and the mean of the number of sides and corners as the "observed value," the discrepancy will cause a predicted 3% error solely from missing data. In terms of results, though, the sides will still be grouped in the appropriate direction, there will just be less data to represent the alternating sides of wellheads with less than eight directional values. Figure 6-6 demonstrates this fact with a density histogram. As long as an average is taken of the data to scale it among sides, the result will be relatively the same as having the same amount of data for all eight directions. However, this does not take into account the error in determining the actual direction each side and corner is facing in relation to the rest of the data in its range.

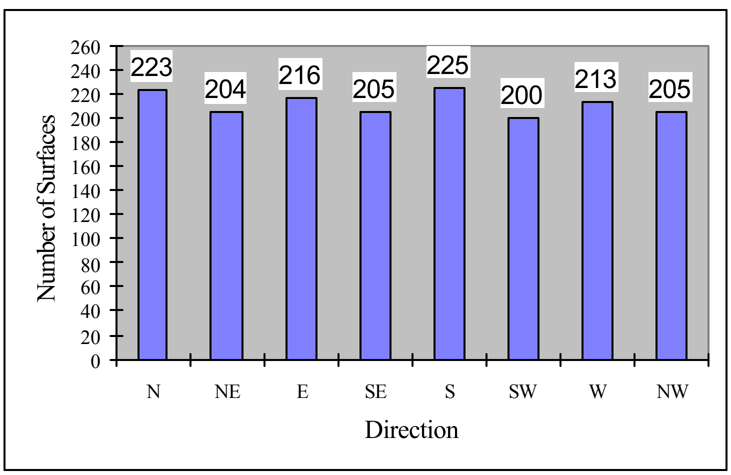

Figure 6-6 Number of Surfaces Histogram

6.4.2 Direction Sorting

The range of this error is constrained by the nature of the data, which physically restricts directional values into no more than 22.5 degrees away from aligning perfectly with the desired result. This can be applied where north is defined by a side or corner facing exactly 0 degrees from north, northeast is defined by a side or corner 45 degrees from north, and so on. If the wellheads were geometrically perfect and there was no equipment error or human error, this would not be a problem, however reality dictates that not all sides and corners on even an eight-sided wellhead are 45 degrees apart.

Possible solutions for this discrepancy include, but are not restricted to, smoothing of the data by taking the average for three separate ranges with a set degree offset in both the clockwise and counterclockwise directions as illustrated by Figure 6-7. Alternatively, graphic modeling of smaller sub-divisions may be used to determine the general extent of smoothing without producing actual values. This technique functions on the concept of merging data points from adjoining positions to create a more sweeping average. We used both of these methods to see if we could determine anything useful from the information we collected.

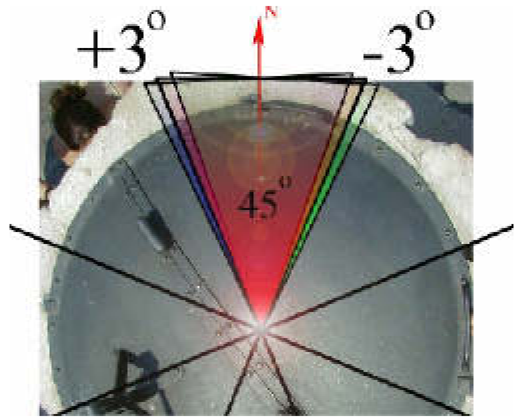

Figure 6-7 Example of Data Smoothing

6.4.3 Smoothing by Range Offset

We executed a ±3 degree range offset analysis as described in the previous section, using the four directional models for simplicity. We figured that human and equipment error would likely be no more than three degrees off in either direction, so we would be able to get an idea of how much this could affect the results. If two adjacent directional values fell into the same groupings due to the actual shape of the wellhead, it would not matter in the average of 217 points representing each side.

The results of both the ±3 degree average and the straight four directional model, can be seen below in Figure 6-8, and the difference is not obvious. For our purposes, further investigation of the problems associated with borderline values was determined to be unnecessary.

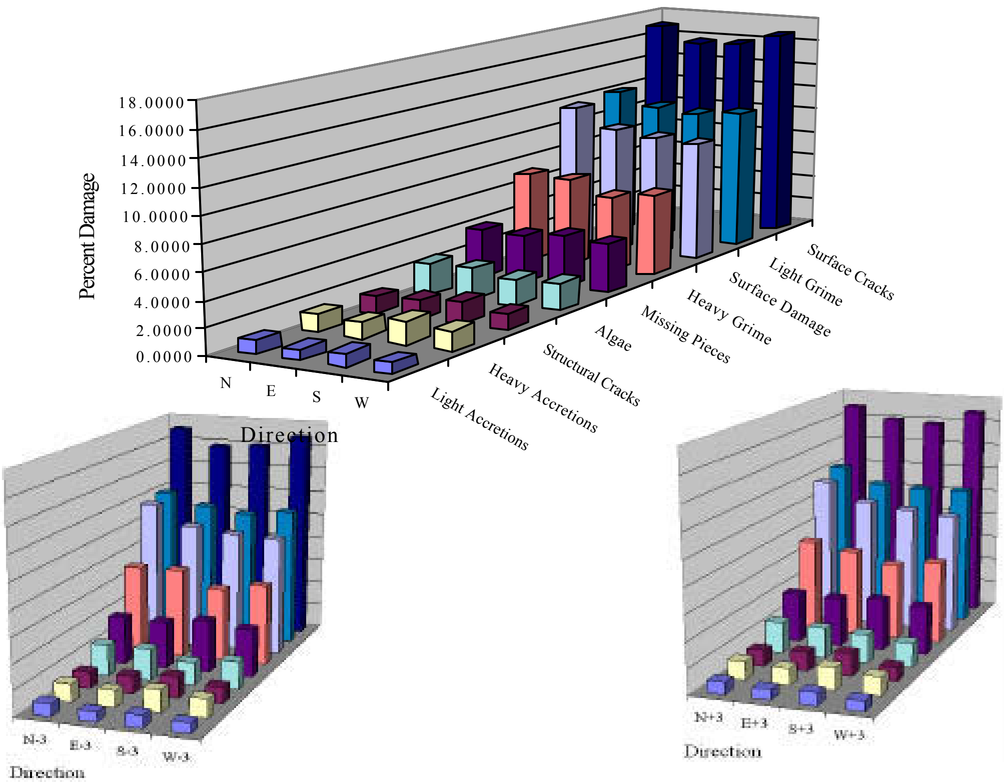

Figure 6-8 Directional Analyses of Damage Assessment

6.4.4 Graphic Modeling

We repeated the process of sorting the values by direction without using the ±3 degree averaging to obtain results and make our conclusions. As illustrated by Figure 6-9, the 8-directional model

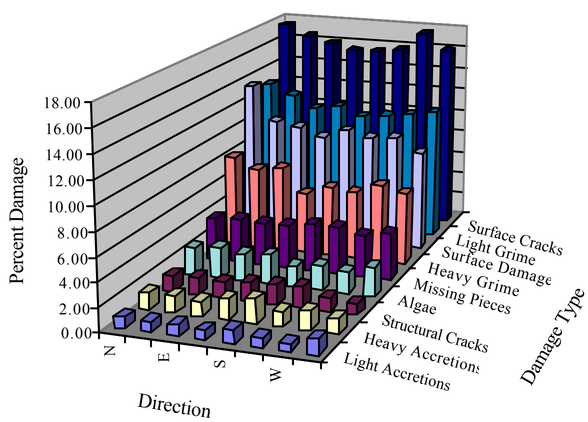

Figure 6-9 Eight Direction Damage Analysis

produces the easiest to interpret values. It is from this particular analysis that we created the final visualization of our data.

Although the graphs generated in the previous section s can give a general idea of the distribution of deterioration in general, the coverage of specific threats can be best represented by a Radar graph. These graphs are generated by placing points by their value away from the center of the graph in the direction of their relevance. Figure 6-10 shows the nine such graphs of the directionally sorted state of conservation data in order of severity.

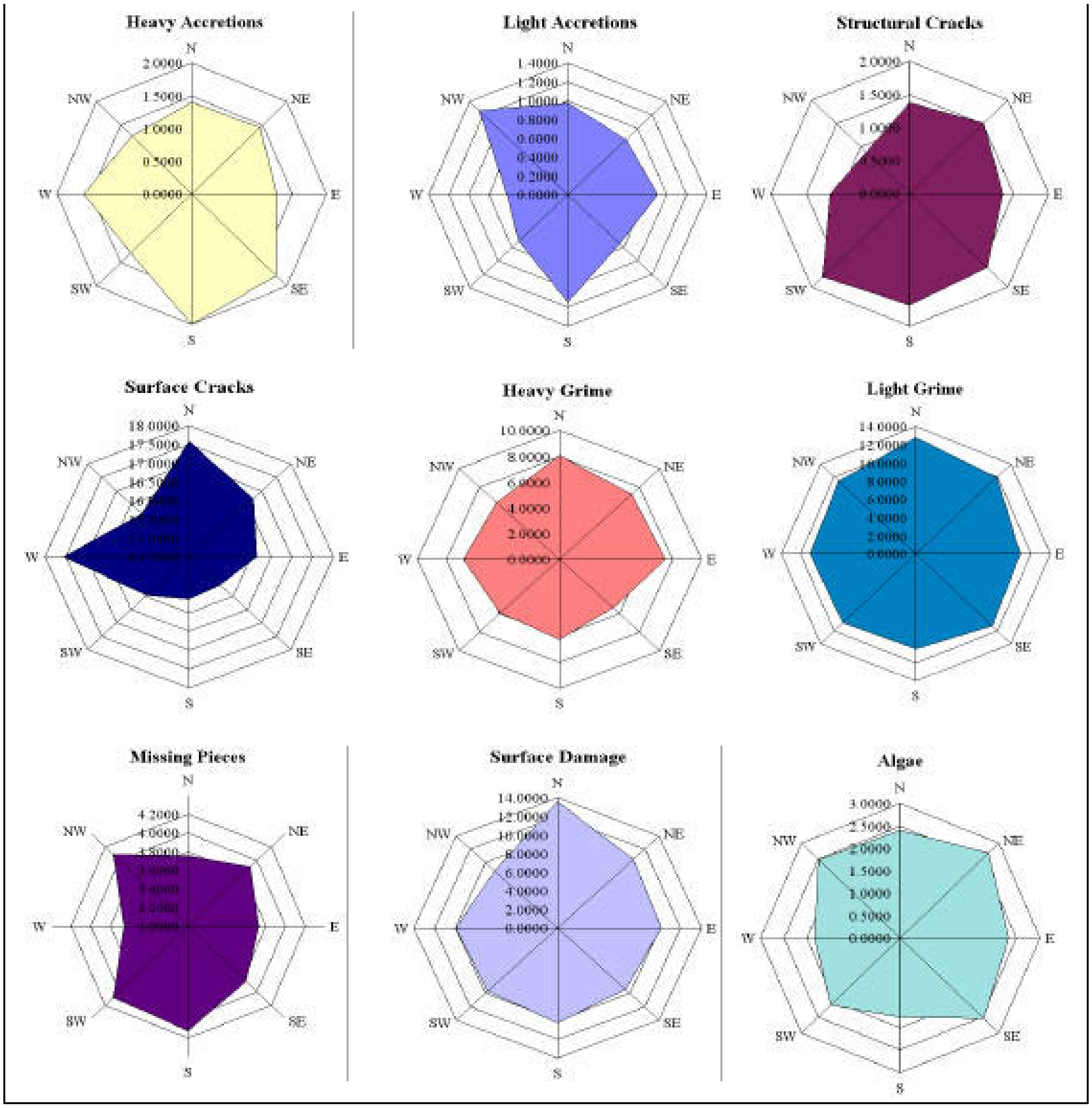

Figure 6-10 Directional Analysis of Damage Types

6.4.5 Summary

From this analysis, we can conclude that there is a noticeable trend in the locations of deteriorating factors. The usefulness of this information could be further explored by focusing on directionally dependent factors in the environment. We hypothesized that possible causes for the trends could be weather patterns and the effects of direct sunlight, but our team did not have the time or resources to pursue this further. Determining definitive sources of causality may lead to progress in preventing damage to stone surfaces beyond wellheads. We offer some possible avenues to explore in Chapter 7 pertaining the ways of preserving, and creating public awareness for, the wellheads.

Chapter 7 - Recommendations and Conclusions

From the beginning, we intended to create a catalog of all public Venetian wellheads in order to promote their preservation through encouraging action. We have provided the tools by which to proceed, but at a substantial cost in time and resour ces. In order to perpetuate the efforts we have made on a voluntary basis, money must be allocated toward wellhead preservation. Therefore, our final step is guiding other organizations in the right direction. Although conducting a thorough study of the pu blic wellheads of Venice allowed us to collect massive amounts of information and compile it into a very powerful and useful resource, without funds and further research, it will be wasted.

The purpose of this chapter is to suggest options and ideas to th ose interested in preserving and restoring the wellheads of Venice. Research on creative fundraising and how to draw attention to the wellheads, highlight the sections that follow. We begin with ideas that non -research organizations may implement or modif y to directly affect change. Further research on these recommendations, carried out by preservation organizations, would be minimal. We go on to discuss further avenues of interest to explore when conducting research on wellheads and state of conservation in general.

7.1 Public Awareness Aids

As previously mentioned in Chapter 4, we developed three main tools that can be used by future groups to increase public awareness. These include walking tours, an educational program, and a web site, all of which can be used to target different demographics. In creating these tools, we hope to provide future organizations with the appropriate resources to further promote public awareness.

7.1.1 Walking Tours

As we mentioned in the methodology, three types of walking tours hav e been developed. These walking tours, which can be found in Appendix C, will not only further educate tourists about the wellheads, but through the sale of these brochures, money will be raised to put towards preservation efforts. These self-guided walk ing tours should inspire tourist organizations to develop more wellhead and public art walks, especially through areas that are not frequented by many sight -seers. This will not only give tourists a taste of the inside of Venice, but will also help reduce the crowds throughout the high traffic areas in the city.

7.1.2 Education

We have developed an educational program in conjunction with the WPI External Sculpture 2000 team to promote Venetian art history in the younger generations. It entails students building models of various Venetian art pieces, learning about water supply, researching family and Venetian history, along with other interactive projects. The complete unit developed by the teams can be seen in Appendix I.

There is still a need to educate adult s about the history and the current deterioration of the wellheads. An idea for a future wellheads project is to design educational programs or seminars that will educate the older generation. Such a program would be a continuation of the current educational program and would further encourage wellhead preservation.

7.1.3 Web Pages

The best way to convey information to an infinitely large audience is through the World Wide Web. We strongly recommend creating a web site, which will inform anyone interested in public art or Venice, about the wellheads. We suggest creating three different sets of web pages: one for researchers, one for tourists, and one for children. (See Examples in Appendix L)

The web page for researchers should contain all the detailed history of the wellheads, along with the up to date deterioration and restoration information.

The web page for tourists should contain a basic outline of the history of the wellheads and cisterns, and explain why they were and still are important to Venice. This page should boast many beautiful pictures of the wellheads, and interesting stories about them. There should also be a section for donations to the organization running the web site for the cleaning and restoration costs. You could start an 'adopt a wellhead program', in which the tourist, who might be in the other end of the world, would look through the pictures and find a well they want to save, then donate money for its restoration cost. They could receive a picture of their well and a little certificate that says they contributed to saving it.

The web pages for children should be designed to stimulate the children's interest in wellheads, teaching them about their art and how they work. Fill the pages with games and activities such as, design your own wellhead, matching tags, and lots of activities such as the ones written in the educational program (See Appendix I).

7.2 Recommendations for Preserving Wellheads

The following section details ideas on constructing a publicity campaign in order to attract attention to the wellheads in hopes of swaying public interest. From conversations with local residents during fieldwork, we noticed that most people felt bad about the condition of the wellheads, but did not think anything would be done since they pale in comparison to other art in the city. Most of our recommended strategies rely on linking the wellheads with other art through association whether by adding supplements to walking tours, creating web sites that include web pages with other art, or in just creating merchandise that incites the curiosity of tourists.

These recommendations are for organizations interested in a "Save the Wellheads Campaign." Through creative fundraising, money can be raised not only for regular maintenance and restoration, but also to implement our proposals of making the wellheads useful to people once again.

7.2.1 Fundraising

In planning fundraising programs we suggest incorporating the following strategies:

1. Seek broad based community support

2. Concentrate on public awareness and education
3. Create realistic programs suited to the community's needs and resources
4. Emphasize long term care and maintenance
5. Make a connection between donor and sculptor
6. Recognize donors often and visibly [43]

By incorporating these fundraising strategies in wellhead programs, it would be easier to get people enthusiastic about restoring and preserving the wellheads.

To establish broad based community support, multiple demographics in Venice must be targeted, the citizens first and foremost, the employees in the areas surrounding each individual wellhead, the government, and lastly, the tourists. The support of each group is important for maintaining a high level of interest in the conservation and restoration of these pieces of art, so their history and presence in Venice is maintained.

When concentrating on public awareness and education, it is again important to target all groups of people. We have created an educational program, which will be discussed later in this chapter that can be used to educate school children about the wellheads. The program we created can be used as a tool for teachers, and can be easily implemented into the school program based on the resources available to them.

The maintenance is just as important as the initial restoration of the wellheads. It will not suffice to simply restore each wellhead just once. Continuous care must be given to the wellheads in order to ensure their preservation.

Donations can be a key factor in raising money for the wellheads. Frequently carved into the wellheads are the crests of families who donated money towards the construction of the original cistern. We recommend finding out which crests still remain on the wellheads and contacting the families for donations in order to restore a part of their family history. A list of all the family crests found on the wellheads, and the campi in which the wellheads are located, is in the Rizzi Information sub-section of the database (See Appendix B). If the crests could be traced to the remaining families throughout the city, it would create a direct connection between the donors and the wellheads. The families and other donors could then be recognized on plaques next to the wellhead, or on the lids of the wellheads to let the public know of their contribution.

Along with the family crests, it is important to preserve other carvings and inscriptions on the wellheads. It may be possible to encourage local churches to allocate funds towards wellhead restoration if there is a wellhead that bares a carving of a saint having the same name as the church, in honor of their congregation. San Zaccaria is a perfect example, and has a beautiful wellhead located in it's campo which is number 205 on our restoration prioritization list.

[43] Fund-Raising Tips, Tales and Testimonies- Private-Public Partnerships to Save Outdoor Sculpture. ©1994. National Institute for the Conservation of Cultural Property.

People interested in images of angels, flowers, saints, or just interested in preserving art can also donate money to the restoration of specific wellheads.

7.2.1.1 Creative Fundraising Suggestions

Community involvement is also important as mentioned previously. Wellhead shaped containers could be placed on the counters in local shops, which would allow customers the opportunity to deposit their spare change into the container. Volunteers could then collect the money as deemed necessary. Another way to get the local merchants involved is by supplying them with promotional materials to sell to tourists, such as t-shirts, postcards, posters, bookmarks, and calendars. (Some examples of these can be found in Appendix F) Although few wellheads related items can be found already, supplying more would help further promote wellhead awareness. These items would draw attention to the wellheads, and demonstrate their role as works of art.

The long tradition of tossing coins into a well or fountain for good luck can also be applied to the Venetian wellheads. Turning some wellheads into wishing wells would be an easy way of raising money for preservation. Implementing a device in the lid of the wellhead, which would collect and store change from passersby, would not require large amounts of additional funding, as many of the lids need to be replaced and these lids could be equipped with such a device. A list of wellheads we recommend for this process can be found in Appendix K.

Combining all of these methods of fundraising along with other effective strategies would allow for many wellheads to be cleaned and restored so they will remain for generations to come.

7.2.1.2 Involvement of Local Residents

Along with vendors, the citizens encounter the wellheads on a regular basis. This constant interaction with the wellheads should lead to an increase in the desire to see the wellheads restored. By combining efforts, the citizens of Venice could implement the signing of petitions, to give to the government of Venice, stating the need for restoration of particular wellheads. Also, locals could clean and fill the water dishes for the animals in the area, decorate the wellhead area with flowering plants, discourage the children in the neighborhood from sitting on the lids, and preventing further vandalism. These actions will not only increase public awareness, but also increase the cleaning and restoration efforts of the local government.

7.2.2 Beneficial Changes to Wellheads

Making the wellhead lids functional by replacing them with sundials, flower containers, or tourist directories, we encourage respectful interaction with the wellheads, and discourage vandalism and other damaging actions.

7.2.2.1 Sundials

Since fifty-five of the metal lids are flat, we thought it would be useful to give travelers and Venetians a way to establish the time of day by turning some of these lids into sundials. This would be very useful since many of the clock towers and bell towers in the city no longer keep accurate time. The lids located in large campi throughout the city wou ld be appropriate for the sundials because of their many hours of daylight. We recommend this application be applied to wells that are publicly visible and are located in sunny campi, especially on wellheads that have lids that need to be replaced due to rusting. A list of the wellheads we chose for this application can be found in Appendix K. An example of what the sundial could look like can be seen in Appendix M

7.2.2.2 Flower Containers

In our fieldwork, we came across a few wellheads with flowers filling the top instead of having a solid lid. The presence of the flowers discouraged people from sitting on the wellhead and defacing it, which could help in preservation. We found through our fieldwork that not a single one of the twelve wellheads used as flower containers had graffiti. We strongly believe that if a wellhead is restored and transformed into a flower container, graffiti will not reappear.

Several wellheads in Venice are capped with concrete, which expands at a higher rate compared to the stone material of the wellhead. This causes structural damage to the wellhead, whic h could be

Figure 7-1 Wellhead with Flowers

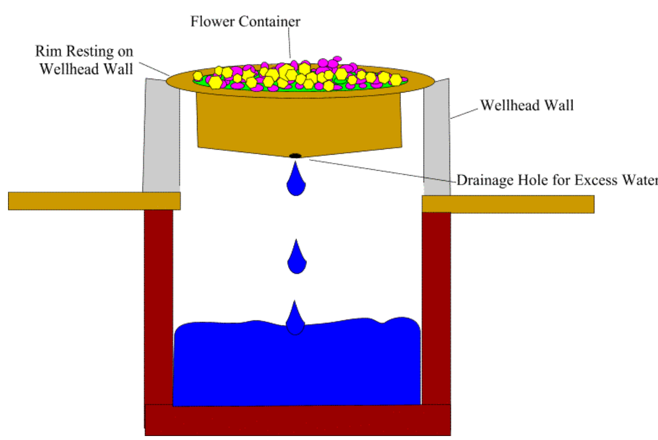

Figure 7-2 Cross-Section of a Flower Container

prevented. We recommend taking the wellheads that are currently capped with concrete, and removing the unwanted material from inside of the wellhead.

There are two different methods that could be safe for constructing flower containers inside of wellheads. One is to place a plastic lining inside a wellhead that has a filled well shaft. Another is to place a stiff plastic or metal container inside open well shafts. The rim of this container would rest on the top of the wellhead, causing no m ore damage or stress on the wellhead than the common metal lids. This container would also have small drainage holes to let excess water leak out into the cistern to prevent the roots from rotting. (See Figure 7-2)

After it is placed in the wellhead, the lining or container would be filled with soil and plants with small root systems as to avoid any chances of the roots damaging the stone.

Locals can get involved in planting new flowers every year, and keeping the plants watered, fertilized, and weeded. A list of the wellheads that we recommend for flower containers can be found in Appendix K.

7.2.2.3 Tourist Directories and Informational Plaques

Another idea for making wellheads functional would be to turn several of the lids of the wellheads into raised maps for the tourists to use. Quite often while walking in Venice one finds lost tourists looking for Saint Mark's Square or the Rialto Bridge. The lids could help them find their way around the city, clearly labeling important landmarks, boat stops, water closets, along with their current location. We recommend maps that show the entire city, which would give the viewer a general idea of where they are in the city. We also recommend maps that are Sestiere specific or island specific depending on how detailed the map should be. It would be most beneficial to put these lids on wellheads that are publicly visible all over the city. We recommend adding these maps to wellheads number 1, 130, and 182 since they are in popular areas throughout the city. The maps for these lids are in Appendix M

Another possibility is to place markers on or near the wellheads, which would tell individuals about the history of these structures. Such information would include the dimensions, the artistic style and the location of the well. The sign will be made in brail along with several different languages, so as to speak to a larger population. Each person that visits the well would have the opportunity to be educated about its history. This would be an excellent way to increase the amount of knowledge people have about the wellheads, and would also promote public awareness.

A list of organizations or individuals who contributed in some way, to the preservation of the wellhead can also be placed on these markers. By providing information about wellheads and acknowledging those who support wellhead preservation, we can hope to influence others to do the same. Such a program may stimulate wellhead restoration and aid in preserving Venetian culture.

7.3 Proposed Projects

This section contains future project ideas that would promote restoration, and provide further information about the wellheads to all persons who are interested. It is important to create informational and educational programs so that people can become more aware of the artistic and historic importance of wellheads in Venice.

7.3.1 Water Testing

All of the information we collected pertains to the external nature of the wellheads. The state of the wellheads could be further understood by obtaining interior inf ormation. Such a project would include testing the Ph level and performing a bacterial test on the water inside each cistern. This would help answer questions such as, "Is the water in the well drinkable?" "Is it hazardous?" or "Can these wells be made fu nctional?", such factors would also help in cost analysis. These tests can be performed through the holes in the lids, or done when the lids are replaced, and do not have to be expensive, just accurate.

7.3.2 Restoration Deterioration

While cataloging the well heads and assessing the state of conservation on each side and corner, we did not include any deterioration on previously restored areas since they are not part of the original wellhead (patches of concrete filling structural cracks, etc.). While catalogi ng the wellheads, we noticed that the restoration patches seemed to be more prone to deterioration than the actual wellhead. We propose that there be a study to see if this is true, and if so find out how much faster the restoration patches deteriorate. A majority of the restoration is done with concrete, which has a different thermal expansion rate than most stone, thereby causing problems to the structural integrity of the stone. Knowing if these theories are true would help in future preservation and res toration techniques.

7.3.3 Graffiti

At the start of our project we had planned on incorporating a graffiti section in our database that would help track repetitive graffiti artists. Due to time constraints we were unable to develop such a system for tracking vandal's tags. However, if done correctly, such a project would discourage graffiti on the wellheads and would help keep the surface of these structures in their original condition. This project could even be expanded to include vandalism throughout the city of Venice. We recommend using an image recognizing software program and photographing each tag on the lids and wellheads themselves. Then one could mark the repetitive tags on a thematic map looking for patterns. This method has been used by police a nd is effective in catching vandals.

7.3.4 Directional Analysis

The angle from north of each side and corner was taken when measuring the deterioration. We hope to find a relation between degrees from north and prevalent types of deterioration, but when we graphed out results, none were found. We recommend doing this study with more variables than time allowed us to take, such as the amount of light that gets into the campo each day, the size of the campo, the frequency of interactions with the wellheads, the l ocation of the nearest water source, and any other information that might effect the deterioration. If a directional correlation is found, it might help in future restoration and preservation.

7.3.5 Wellhead Documentary

A quick yet informative way to tell others about wellheads would be through a documentary. For a future project, students could create a documentary or a public service announcement containing a brief history of Venice, the history of the wellheads, and their current conditions. It could also contain interviews of art historians, residents of Venice, discuss restoration possibilities, and other subjects that would help voice wellhead preservation. Although such a project would require familiarity with media equipment and long hours of editing, when combined with a written report the outcome could be very successful in aiding preservation efforts.

7.3.6 Future Cataloging Projects

Students before us have worked on wellhead projects and they too had the responsibility of promoting public awareness. Our efforts are a continuation of those of previous teams, adopting new ideas and making use of improved software and various technological advances. Future wellhead projects might want to focus on promoting public awareness, completing another analysis of the wellheads state of deterioration to see how rapidly deterioration actually occurs, or creating a more extensive education program, to name a few.

7.3.6.1 New Public Wellheads

Many of the wellheads that we cataloged were public nineteen years ago, but are now private. We assume that there are wellheads that were private and are now public. We propose that there be a project to find the recently turned public wellheads that were not cataloged by Alberto Rizzi. This would make the database truly complete, but would take a long time to scour the streets of Venice, or to look at aerial shots of the city.

7.3.6.2 Islands of the Lagoon

We had hoped to go to the Islands of the lagoon to catalog the other sixty public wellheads, but simply did not have enough time. We also did not have any readily available detailed maps of where the wellheads are located. We propose cataloging these wellheads on Murano, Burano, Torcello, Lido, Malamocco, S. Pietro in Volta, Portosecco, Pellestrina, and Chioggia, and including them in the Pozzi layer on Map Info. This would help to make the database we created even more complete.

7.3.6.3 Private Wellheads of Venice

An interesting project to pursue would be to make a complete deterioration catalog similar to ours of the private wellheads of Venice. This catalog would have to be pursued by a group fluent in Italian, and would propose a challenge of getting into private campi, but would be interesting to compare to our database to see if the deterioration status of private wellheads is generally better or worse than public wellheads. This data would lead to new recommendations for the status of wellheads.

7.4 Conclusions

No one can save all art. Eventually, even that which is written in stone will begin to lose its meaning in more than just physical detail. However, if we learned nothing else from our experiences in Venice, Venetians do not build things to watch them fade. Beauty is everywhere in Venice and the city itself is a triumph in the face of overwhelming ethereality, but somewhere within its streets, culture and art is slowly dying. Beneath street maps laid out by tourists, desperately seeking a familiar landmark, the wellheads sit quietly ignored. The rare attention that wellheads do receive usually comes in the form of graffiti, or in the form of a question: "What is that?" This is not the fault of the Venetians, nor can the blame be placed on anyone or anything but the beautiful city itself. Considering the pure magnitude of public art in Venice's architecture, landmarks and publicized attractions, a carved, cylindrical piece of stone seems to pale in comparison. The question we must ask ourselves is whether or not this is right.

We created a catalog of every public Venetian wellhead that exists today, but we cannot use the information to convince someone who has no concept of what a wellhead is that something should be done about the stone deterioration. What we can use this information for is to help those organizations that are fighting to ensure that culture and art will not die from ignorance and apathy. Our efforts and outputs are here to help ease their struggle and in doing so, we may continue to see public Venetian wellheads. No one can save all art, but we did what we could.

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Appendix A - Annotated Bibliography

The following annotated bibliography explains each book used in our research, along with our impression of its importance to the project.

A.1 Amoroso, Giovanni. Fassina, Vasco. **Stone Decay and Conservation*****. New York: Elsevier. 1983.***

This book was very helpful in understanding why the wellheads were corroding for other reasons than vandalism. It explained in great detail corrosion due to things such as, water, salt air, pollution and frost. It had specific cases using Venetian art and related very much to our project.

A.2 *Boriakoff, Alexander; Ian Buckley; Kristen Magnifico.* **A Computerized Catalog of the Well-Heads of Venice in the Sestiere of Dorsoduro**. *Interactive Qualifying Project, 1995.*

This IQP from 1995 was not very useful in furthering our understanding of Venetian wellheads. The style of writing was rather poor and there was not much background information. The background information, which was given, was mo stly geared toward the geography of Venice and its development, as opposed to actual wellheads themselves. There was very little discussion about the characteristics of wellheads, including their carvings, inscriptions, and the style based on the time -period. Although it was very lengthy, most of it's contents were photographs of the wellheads the group had cataloged and very basic information pertaining to the possible uses of wellheads today.

Other contents include interviews, which were conducted bot h in the United States as well as in Venice. The interview with Dr. Manuele Medoro of the Venetian Department of Public Works allowed us to gain further insight into the restoration process performed on wellheads. It also explained the cost of cleaning and restoring a wellhead, and the process that the Venetian authorities undergo to differentiate wellheads in need of repair.

Their methodology outlined the process they underwent to create the field form which we will most likely be using to determine the condition of each wellhead. This section went into great depth about the acquisition of necessary data pertaining to each wellhead.

Their results section was very detailed, however, they did not seem to be confidant in their evaluation process. The writing made it sound as though they were surprised to see the results they had obtained. This lead our team to feel as though this source was not very reliant.

A.3 Davis, John Hagy, Venice. *New York: Newsweek, 1973.*

This book was not very useful to us for finding information on wellheads or information that might have been useful in our background. It was more of a book about the history of Venice. At the end of the book, there is a section of excerpts from books, poems, short stories and other forms of literature written about Venice. We found these interesting, but not very useful.

A.4 Fitch, James Marston. __Historic Preservation: Curatorial Management of the Built World__*. Charlottesville. University Press of Virginia. 1990.*

When looking for persuasiv e arguments and reasoning behind preserving the wellheads of Venice, the book offered a fresh, focused perspective on the methodology of the feat. It was not very useful for direct references for the paper, but it read a lot like an argumentative essay in parts which was helpful to get an idea on how preservationists "feel" about the preservation effort in any field. It gave a new angle to look at, but was not a good reference.

A.5 Knopf, Alfred A., Knopf Guides: Venice Italy. New York: Alfred A. Knopf, Inc., 1993.

This guide proved to be very useful as it contained information pertaining to the construction of cisterns and the various styles of wellheads.

The construction of Venetian cisterns was described very briefly; and several drawings were found to be very useful.

Using the Architecture section of this book, we were able to understand the various time periods in which the wellheads were constructed and what their characteristics would be for the Byzantine, Gothic, Renaissance, and Baroque period s. Each style of wellhead was pictorially depicted according to the century in which they were built.

A.6 Marqusee, Mike,* Venice: an Illustrated Anthology. *Topsfield: Salem House, 1989.

A nice representation of Venice History using pictures; describes th e history of Art, Architecture Music, and more; Does not include anything on Wellheads so it was not used.

A.7 Rizzi, Alberto. The Well-Heads of Venice. Stamperia di Venezia Editrice, Venezia 1981.

The main source of information for our project is the bo ok entitled *Vere da Pozzo di Venezia* or *The Well-Heads of Venice* by Alberto Rizzi. See Figure 3-17 for a picture of the cover. We used this book as a guide and a reference to finding the history, material, and loca tion of each wellhead. The photographs contained in this catalog proved to be a convenient tool when trying to locate a particular wellhead when there were many in a small area. We also used the numbering system in the book as our official numbering system for all 232 wellheads in Venice Proper.

A.8 Rossi, Guido Alberto, <u>Venice From The Air</u>. *New York: Rizzoli, 1988.*

This book contains some beautiful photos of Venice, but only three of them have a wellhead in them. The three pictures of the wells were t oo far away to show any detail so they were not used.

A.9 Ruskin, John, <u>The stones of Venice</u>. *New York: United States Book Co. 1851.*

A three-volume collection about architecture throughout Venice's history. These books would be very useful to someone who needed information about building construction styles in Venice, but they were not very useful for our project. They did not have any information on the construction of wells or the materials they used.

A.10 Schuster, J. Mark. **<u>Preserving The Built Heritage: Tools For Implementation</u>.** ***Hanover: University Press of New England. 1997.***

This book was great. Sections on of the paper were influenced heavily by the insight into the limited ability of the government to enact change. For anything that requires go vernment intervention of any sort to preserve anything; read it. It may focus on preserving built monuments, but it will give a great insight into dealing with limited government resources. Particular interest is the outline on page 5, which gives the ge neral concepts in the book, each chapter expanding on the concepts to the point of examples and well-documented references. But, don't take my word for it…

Appendix B - Database Field Definitions

The wellhead catalog is divided into 7 sub -sections including Basic In formation, Side Deterioration, Corner Deterioration, Consumption of Features, Graffiti and Improper Uses, Rizzi, and Special Details. Values could be numerical with inferred units such as the height, length and width measurements, true or false as with th e existence of rust on the surface on the wellhead, or text fields for notes and location data. The label for the database fields, their type and a brief definition of their purpose in the database is listed in table format within this appendix in the fol lowing order:

1. Basic Information
2. Sides and Corners Information
3. Consumption of Human Features
4. Improper Use
5. Rizzi Information
6. Special Details

B.1 Basic Information Definitions

Database Field	**Type**	**Definition**
Identification		
RizziNumber	Numerical Value	Reference numbers taken from the book by Alberto Rizzi, The Wellheads of Venice; serve to identify and differentiate the public wellheads of Venice
Sestiere	Text Field	Name of the Venetian Sestiere in which the wellhead is located
Location	Text Field	Name of the immediate area in which the wellhead is located in terms of the campo, piazza, or otherwise
Wellhead Specifics		
Wellhead Material	Text Field	Material of the wellhead
DegreeOfNorthMostSide	Numerical Value	Degrees of the side facing closest to 0 (or 36 0) degrees counting clockwise away from Magnetic North
CircularTop	True or False	Whether or not the top of the wellhead is circular in shape
CircularBottom	True or False	Whether or not the base of the wellhead where it contacts the platform or ground iscircular in shape
CircumferenceOfBase	Numerical Value	Measurement in centimeters of the base of the wellhead where it comes in contact with the platform or ground
HeightFromBaseToRim	Numerical Value	Height measured in centimeters from the base of the we llhead to the top, excluding the lid if applicable
WellheadWallThickness	Numerical Value	Measurement of the distance from the outside of the wellhead wall to the inner wall
NumberOfSides	Numerical Value	The number of sides of the wellhead as determined from logically seperating sections by platform sections, sides on a wellhead that had

		defined sides, or by some other easily recognizable permanent feature
Platform Specifics		
Platform Material	Text Field	Material of the platform
PlatformWidth/Circumference	Numerical Value	Width and/or circumference of the platform as measured in centimeters
NumberOfSidesOfPlatform	Numerical Value	Number of sides of the platform only if literally applicable
PlatformCircular?	True or False	Whether or not the platform is circular
PlatformHeight	Numerical Value	Height of the platform measured in centimeters
NumberOfStepsOfPlatform	Numerical Value	The number of steps of the platform if applicable
Lid Specifics		
LidCircumference	Numerical Value	Circumference of the lid measured in centimeters
LidDiameter	Numerical Value	Diameter of the lid measured in centimeters
Lid Material	Text Field	Material of the lid
Lid Shape	Text Field	Shape of the lid in terms of whether or not it is flat or curved
Importance Factors		
Historic	True or False	All wellheads built before approximately 1300 AD are classified as "historic"
PublicVisibility	True or False	Whether or not the wellhead is located in a relatively high-traffic area in terms of passing people
Popularity	True or False	Determined by multiple factors including whether or not people are in contact with it during field data collection, information gathered from people in the immediate area, and loosely based on public visibility combined with aesthetic value
Rarity	True or False	In the case that a wellhead has a particular feature or otherwise that sets it apart from a majority of the other wellheads, it is considered rare
ArtisticImportance	True or False	If the wellhead was deemed to have artistic importance in terms of specific artisans or purely high aesthetic value
Miscellaneous		
MetalAccessories	True or False	The existence of metal accessories such as brackets, water spouts or anything else on the wellhead that was made of metal excluding the lid
Rust?	True or False	The existence of rust on the surface of the wellhead
Illegibility	True or False	On wellheads that had inscriptions: illegibility of the message
NumberOfDrains	Numerical Value	The number of drains assumed to be part of the original structure
PreviousRestoration	True or False	Whether or not previous restoration had been performed on the wellhead

B.2 Side and Corner Information Definitions

The Side and Corner Information database contains information on the deterioration of each side of the wellhead.

Database Field	Type	Definition
Identification		
RizziNumber	Numerical Value	As taken from the book by Alberto Rizzi, The Wellheads of Venice; serve to identify and differentiate the public wellheads of Venice
Side	Text Field	Alphabetical number assigned to each side in a clockwise fashion from the north most side
DegreesFromNorth	Numerical Value	Degrees of the side counting clockwise from magnetic North
Damage Assessment		
Accretions2	Numerical Value	Paint accumulations including graffiti that obscures the surface of the wellhead completely
Accretions1	Numerical Value	Paint accumulations that are sporadic as in the edge of spray paint marks or tiny spattering that still allows wellhead to be seen within it
StructuralCracks	Numerical Value	Any cracks which are deep into, or all of the way through the wellhead wall potentially causing severe structural damage
SurfaceCracks	Numerical Value	Minor cracks located on the outermost surface of the wall
Grime2	Numerical Value	Grime, dirt, and soil accumulations that are pervasive to the point of completely obscuring the wellhead in its coverage
Grime1	Numerical Value	Grime, dirt, and soil accumulations that are light enough to still see the stone surface
SurfaceDamage2	Numerical Value	Heavy damage to the surface including missing pieces
Surface Damage1	Numerical Value	Light damage to the surface including pitting, chalking and flaking
Algae	Numerical Value	Biological plant growth which causes damage to the stone composition
Graffiti	True of False	Intentional painted damage to the wellhead
Notes	Text Field	Miscellaneous notes taken on noticeable features

B.3 Consumption of Human Features Definitions

Database Field	Type	Definition
Identification		
RizziNumber	Numerical Value	As taken from the book by Alberto Rizzi, The Wellheads of Venice; serve to identify and differentiate the public wellheads of Venice

	Value	to identify and differentiate the public wellheads of Venice
Side	Text Field	Alphabetical number assigned to each side in a clockwise fashion from the north most side
Consumption of Features		
Right Eye	Text Field	Status of either good, going, gone, or not applicable on whether the feature is recognizable, and what condition it is in (figure's left or right)
Left Eye	Text Field	Status of either good, going, gone, or not applicable on whether the feature is recogni zable, and what condition it is in (figure's left or right)
Right Ear	Text Field	Status of either good, going, gone, or not applicable on whether the feature is recognizable, and what condition it is in (figure's left or right)
Left Ear	Text Field	Status of either good, going, gone, or not applicable on whether the feature is recognizable, and what condition it is in (figure's left or right)
Nose	Text Field	Status of either good, going, gone, or not applicable on whether the feature is recognizable, and what condition it is in (figure's left or right)
Mouth	Text Field	Status of either good, going, gone, or not applicable on whether the feature is recognizable, and what condition it is in (figure's left or right)
Chin	Text Field	Status of either good, going, gone, or not applicable on whether the feature is recognizable, and what condition it is in (figure's left or right)
Right Arm	Text Field	Status of either good, going, gone, or not applicable on whether the feature is recognizable, and what condition it is in (figure's left or right)
Left Arm	Text Field	Status of either good, going, gone, or not applicable on whether the feature is recognizable, and what condition it is in (figure's left or right)
Right Hand	Text Field	Status of either good, going, gone, or not applicable on whether the feature is recognizable, and what condition it is in (figure's left or right)
Left Hand	Text Field	Status of either good, going, gone, or not applicable on whether the feature is recognizable, and what condition it i s in (figure's left or right)
Right Leg	Text Field	Status of either good, going, gone, or not applicable on whether the feature is recognizable, and what condition it is in (figure's left or right)
Left Leg	Text Field	Status of either good, going, gone,or not applicable on whether the feature is recognizable, and what condition it is in (figure's left or right)
Feet	Text Field	Status of either good, going, gone, or not applicable on whether the feature is recognizable, and what condition it is in (figure's left or right)

B.4 Improper Use Definitions

Database Field	**Type**	**Definition**
Identification		
RizziNumber	Numerical Value	As taken from the book by Alberto Rizzi, The Wellheads of Venice; serve to identify and differentiate the public wellheads of Venic e
Side	Text Field	Alphabetical number assigned to each side in a clockwise fashion from the north most side

Improper Use		
Graffiti Description	Text Field	Identifiable graffiti tags; incomplete due to difficulty of finding repeating tags
Improper Use	Text Field	Description of wellhead in noticeably unnatural surroundings, (taken over by restaurant, in private campo, in construction site, etc.)

B.5 Rizzi Information

Database Field	Type	Definition
Identification		
RizziNumber	Numerical Value	As taken from the book by Alberto Rizzi, The Wellheads of Venice; serve to identify and differentiate the public wellheads of Venice
Location	Text Field	Campo in which the wellhead is located
Rizzi Information		
Period Initiated	Text Field	The year or century in which the well was created
Stone Type	Text Field	The material of which the wellhead is composed
Height	Text Field	The height in centimeters from the top of the platform to the rim
Length	Text Field	The length across the top of the wellhead in centimeters (for non-circular wellheads)
Diameter	Text Field	The diameter of the top of the wellhead in centimeters (for circular wellheads)
Animals	Text Field	Any carvings of animals on the wellhead (lions, deer, etc.)
Crest or Shield	Text Field	Any crests or shields on the wellheads, including name, meaning, and origin if available
Figures	Text Field	Any figures on the wellhead along with a description of the figure
Notes	Text Field	Any notes or interesting stories about the history of the wellhead or its origin

B.6 Special Details Definitions

Database Field	**Type**	**Definition**
Identification		
RizziNumber	Numerical Value	As taken from the book by Alberto Rizzi, The Wellheads of Venice; serve to identify and differentiate the public wellheads of Venice
Side or Corner	Text Field	Alphabetical number assigned to each side in a clockwise fashion from the north most side or corner
Special Details		
General Detail	Text Field	Any detail that makes that side unique (carving, metal accessory, etc.)
Specific Detail	Text Field	Details about the general details, such as the family whose shield it is, or the details of what a carving looks like

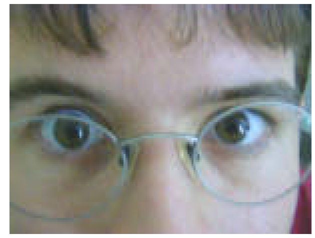
Appendix C - Walking Tours

The walking tours are a set of possible tours that can educate people about the wellheads of Venice. It consists of a map giving directions to various wellheads and provides brief historical information about them.

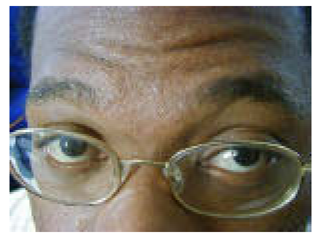
Appendix D - Project Team Biographies

This appendix contains a brief biography of each 2000 WPI Wellhead Team member.

Name: Kevin Anthony Vello
Major: Civil / Structural Engineering
Minor: Mathematics
Class: 2002
Hometown: Phillipston, Massachusetts
Interests: Puzzles, Sports

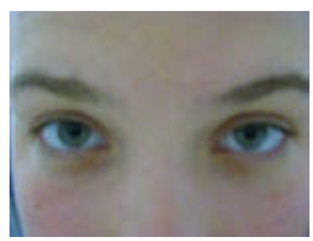


Name: Lewis Edward Blackwell II
Major: Electrical and Computer Engineering
Class: 2001
Hometown: St Louis, Missouri
Interests: Song Writing, Carpentry, Computer Programming

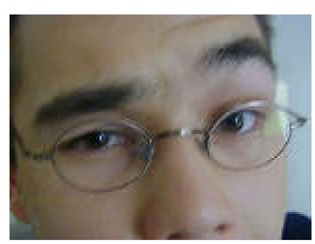


Name: Meghan Ellene Fraizer
Major: Theatre Technology
Minor: Physics
Class: 2002
Hometown: Lowell, Massachusetts
Interests: Theatre, Music, Bicycling

Name: Adria Michelle Rizzo
Major: Civil / Structural Engineering
Class: 2001
Hometown: East Aurora, New York
Interests: Singing



Name: Randall Lee Wainwright
Major: Management Engineering
Class: 2001
Hometown: Doylestown, Pennsylvania
Interests: Computer Graphic Design



Appendix E - Wellhead Location Maps

This appendix contains the maps showing the locations of all the wellheads we cataloged. They are all numbered according to Alberto Rizzi's book " The Well -Heads of Venice" and are represented as small circles.

Appendix F - Wellhead Promotional Merchandise

This appendix contains our examples of wellhead themed products, including: 3 postcards, a bookmark, and a calendar for the year 2001.

Appendix G - Field Forms

In developing the computer catalog for the wellheads, we first performed extensive fieldwork. Appendix G shows the field forms used.

Appendix H - Algorithm

In order to determine which wellheads were in the worst state of deterioration a rule or algorithm was needed to compute a list showing the order in which the wellhead should be restored, the first being the wellhead in greatest need of restoration. This appendix shows the algorithm used in developing the prioritization list.

$$RAU = S_{DA} + S_{IF}$$

RAU	**Restoration Attention Urgency**
S_{DA}	**Damage Assessment Score**
S_{IF}	**Importance Factor Score**

Where,

$$S_{DA} = \sum\left[\sum \frac{D}{s}(W_{DA})\right](W_{ODA}) \qquad S_{IF} = \left[\sum IF(W_{IF})\right](W_{OIF})$$

D	**The percentage of each type of deterioration on a side or corner of the Wellhead**
s	**Number of surfaces**
W_{DA}	**Weighting Value for each individual Damage Assessment Factor**
W_{ODA}	**Weighting Value for the sum of the Damage Assessment Factors**
IF	**A 1 if the Wellhead has the Importance Factor, a 0 if it does not have the Importance Factor**
W_{IF}	**Weighting Value for each individual Importance Factor**
W_{OIF}	**Weighting Value for the sum of the Importance Factors**

Where,

$$W_{ODA} = 10 - W_{OIF} \qquad W_{OIF} = \frac{\sum\left[\sum \frac{D}{s}(W_{DA})\right]}{n}$$

n	**Number of Wellheads**

By combining these four equations the algorithm is created. Through the use of this algorithim we were able to create a Restoration Prioritization list of all the wellheads we had information for, seen in Appendix J.

$$RAU = \sum\left[\sum \frac{D}{s}(W_{DA})\right](10 - W_{OIF}) + \left[\sum IF(W_{IF})\right]\left[\frac{\sum\left[\sum \frac{D}{s}(W_{DA})\right]}{n}\right]$$

Appendix I - Educational Program

To promote public awareness we developed an educational program, for the Venetian youth. The educational program was a done in collaboration with the 2000 WPI External Sculpture Project Team and the 2000 WPI Wellheads Project Team. It entails an educational program aimed at promoting an awareness in Venetian art history, with an emphasis on external sculptor and well heads.

Appendix J - Preservation Prioritization List

This appendix contains a list of all the wellheads in order that they most need to be restored.

Restoration Order	Rizzi Number	Sestiere	Location
1	226	Dorsodoro	Corte De L'aseo
2	181	Santa Croce	Corte Correra
3	195	Santa Croce	Porte Del Tagiapiera
4	15	San Marco	Campo S. Fantin
5	11	San Marco	Campiello S. Zulian
6	22	San Marco	Corte dei do pozzi
7	16	San Marco	Treato La Fenice
8	45	San Marco	Corte Contarina
9	33	San Marco	Salizada Malipiero
10	135	Canaregio	Corte de la Pegola
11	125	Canaregio	Campo dei Mori
12	224	Dorsodoro	Campiello De Ca' Bernardo
13	40	San Marco	Corte Barbarigo
14	36	San Marco	Corte de le Pizzocare
15	220	Dorsodoro	Campo S Nicolo dei Mendigoli
16	21	San Marco	Corte dei do pozzi
17	20	San Marco	Corte del Teatro S. Moise
18	55	Castello	Corte Formenta
19	118	Canaregio	Corte Erizzo
20	60	Castello	Corte Soranzo
21	47	San Marco	Corte Del Forno Vechio
22	187	Santa Croce	Campiello De La Chiesa
23	171	San Polo	Campo S Agostin
24	8	San Marco	Corte del Spiron D'Oro
25	5	San Marco	Corte S Zorzi
26	23	San Marco	Campo S. Maria Zobenigo
27	196	Santa Croce	Campo S. Zan Degola
28	27	San Marco	Corte de le muneghe
29	24	San Marco	Sotoportego Soranzo
30	13	San Marco	Corte Del Tentor
31	124	Canaregio	Corte de la Rafineria
32	121	Canaregio	Corte Loredan

33	6	San Marco	Campo Rusolo o S. Gallo
34	94	Castello	Campo S. Lio
35	172	San Polo	Campo S. Stin
36	26	San Marco	Campo S. Maurizio
37	212	Dorsodoro	Corte Canal
38	197	Santa Croce	Campo S. Stae
39	66	Castello	Campo S. Ternita
40	85	Castello	Campiello del Tagiapiera
41	168	San Polo	Corte Contarina
42	162	San Polo	Corte Barzizza
43	101	Castello	Corte del Peruchier
44	1	San Marco	Piazzetta dei Leoni
45	19	San Marco	Corte Barozzi
46	200	Santa Croce	Corte Del Coregio
47	227	Dorsodoro	Corte de Ca' Surian
48	219	Dorsodoro	Corte Mazor
49	231	Giudecca	Calle Dei Spini
50	163	San Polo	Corte Dei Preti
51	12	San Marco	Corte del Falcon
52	29	San Marco	Campo San Stefano
53	38	San Marco	Corte de L'alboro
54	30	San Marco	Campo San Stefano
55	232	Giudecca	Corte Dei Cordani
56	71	Castello	Corte Querini
57	95	Castello	Campo S. Marina
58	178	San Polo	Chiovere S. Rocco
59	130	Canaregio	Corte Pali Gia Testori
60	177	San Polo	Campo dei Frari
61	169	San Polo	Corte Dei Remor
62	91	Castello	Campo S. Maria Formosa
63	102	Castello	Ramo Primo Brusa
64	180	Santa Croce	Corte Seconda De Ca' Barbo
65	166	San Polo	Corte Del Teatro Vechio
66	43	San Marco	Corte S. Andrea
67	176	San Polo	Campiello Dei Piovan
68	41	San Marco	Campiello Michiel
69	152	Canaregio	Campo S Giovanni Grisostomo
70	141	Canaregio	Campo dei Gesuiti
71	127	Canaregio	Campo Del Gheto Novo
72	129	Canaregio	Campo del Gheto Novo

73	100	Castello	Corte Veriera
74	79	Castello	Campiello Del Vin
75	225	Dorsodoro	Corte Dela Madona
76	228	Dorsodoro	Campiello Del Basego
77	54	Castello	Corte De Le Colone
78	86	Castello	Corte Dei Preti
79	158	San Polo	Campo Rialto Novo
80	87	Castello	Borgoloco S. Lorenzo
81	10	San Marco	Corte Lucatello
82	186	Santa Croce	Corte Canal
83	116	Canaregio	Campo S Marcuola
84	216	Dorsodoro	Corte Larga
85	90	Castello	Campo S Maria Formosa
86	193	Santa Croce	Campo San Giacoma Da L'Orio
87	53	Castello	Campiello de Cassarisina
88	62	Castello	Campo de la Chiesa
89	32	San Marco	Campo S. Vidal
90	164	San Polo	Corte Petriana
91	49	Castello	Campo Rugga
92	192	Santa Croce	Campo S. Giacomo Da L'Orio
93	206	Dorsodoro	Piscina S Agnese
94	131	Canaregio	Campo de le Erbe
95	165	San Pob	Campo S. Cassan
96	64	Castello	Campo San Giustina
97	184	Santa Croce	Corte Del Tagrapiera
98	18	San Marco	Campiello Barozzi
99	199	Santa Croce	Corte Dei Pontei
100	89	Castello	Corte dei Orbi
101	35	San Marco	Corte Lezze
102	188	Santa Croce	Campo S. Simon Grando
103	126	Canaregio	Campo De L'Abazia
104	215	Dorsodoro	Campo de L'Anzolo Rafael
105	223	Dorsodoro	Campo S Margarita
106	112	Canaregio	Campiello de le Scuole
107	115	Canaregio	Campiello Drio ca'Emo
108	207	Dorsodoro	Campo S Agnese
109	160	San Polo	Campo S. Silvestro
110	78	Castello	Corte Michiel
111	218	Dorsodoro	Corte S Marco
112	56	Castello	Corte Nove

113	229	Dorsodoro	Corte dei Preti
114	77	Castello	Campo S. Zane Novo
115	58	Castello	Campo de la Tana
116	44	San Marco	Corte Contarina
117	173	San Polo	Corte del Calderer
118	198	Santa Croce	Campo S. Maria Mater Domini
119	148	Canaregio	Campiello del Remer
120	34	San Marco	Campo S. Samuel
121	204	Dorsodoro	Corte Del Sabion
122	191	Santa Croce	Ruga Vechia
123	99	Castello	Corte Botera
124	52	Castello	Campo S. Isepo
125	103	Castello	Campo S. Giustina De BarBaria
126	67	Castello	Campiello De La Fraterna
127	51	Castello	Corte de la Stella
128	108	Canaregio	Campo S Geremia
129	179	San Polo	Campiello San Rocco
130	142	Canaregio	Corte de la Candele
131	128	Canaregio	Campo Del Gheto Novo
132	157	San Polo	Campo de le vecarie
133	14	San Marco	Campo S. Fantin
134	183	Santa Croce	Calle Del Gesue Maria
135	39	San Marco	Corte Dei santi
136	92	Castello	Corte Perina
137	114	Canaregio	Campo S Leonardo
138	194	Santa Croce	Campo S. Giacomo Da L'Orio
139	109	Canaregio	Campo S. Geremia
140	230	Giudecca	Campo Dela Palada
141	59	Castello	Corte de le Gorne
142	211	Dorsodoro	Corte della Comare
143	76	Castello	Campo S. Filippo E Giacomo
144	221	Dorsodoro	Campo S Barnaba
145	174	San Polo	Campiello De Ca' Zen
146	175	San Polo	Campo S. Toma
147	201	Dorsodoro	Campo del Salute
148	57	Castello	Corte Nove
149	80	Castello	Campo S. Provolo
150	150	Canaregio	Corte Amadi
151	106	Castello	Corte Bressana
152	202	Dorsodoro	Campo S Gregorio

153	119	Canaregio	Campiello De La Chiesa
154	205	Dorsodoro	Campo S Vio
155	63	Castello	Corte De La Pieta
156	139	Canaregio	Corte de la Posta de Fiandra
157	75	Castello	Campo S Lorenzo
158	185	Santa Croce	Corte Candi
159	214	Dorsodoro	Campo Drio al cimitero
160	72	Castello	Campiello del Piovan
161	50	Castello	Corte De Ca' Bianco
162	213	Dorsodoro	Campo de S Basegio
163	182	Santa Croce	Campo Morto
164	97	Castello	Corte Spechiera
165	137	Canaregio	Campo Drio la Chiesa
166	25	San Marco	Campo S. Anzolo
167	37	San Marco	Campo s. Anzolo
168	93	Castello	Corte Rubbi
169	61	Castello	Campo Do Pozzi
170	74	Castello	Campiello Del Piovan
171	217	Dorsodoro	Campiello dei Guardiani
172	70	Castello	Corte Bollani
173	105	Castello	Parocchia Di SS Giovanni e Paolo
174	146	Canaregio	Campo S Canzian
175	117	Canaregio	Campo De La Madalena
176	161	San Polo	Campo S. Aponal
177	170	San Polo	Campo S. Bolo
178	122	Canaregio	Corte Trapolin
179	73	Castello	Campiello Del Piovan
180	83	Castello	Corte Rota
181	88	Castello	Borgoloco S. Lorenzo
182	96	Castello	Campo S. Marina
183	209	Dorsodoro	Campo S Trovaso
184	190	Santa Croce	Campiello De Ca' Zen
185	107	Canaregio	Campo S. Geremia
186	120	Canaregio	Volto Santo
187	110	Canaregio	Campo S Geremia
188	4	San Marco	Corte Gregolina
189	167	San Polo	Campo S. Polo
190	46	San Marco	Corte Coppo
191	151	Canaregio	Corte Seconda del Milion
192	144	Canaregio	Campiello del Pestrin

193	65	Castello	Corte Nova
194	111	Canaregio	Rielo
195	149	Canaregio	Corte Morosina
196	143	Canaregio	Ramo Del Tiziano
197	140	Canaregio	Corte Nova
198	145	Canaregio	Calle de Pestrin
199	69	Castello	Campo Bandiera E Moro o De La Bragora
200	42	San Marco	Campo S. Beneto
201	68	Castello	Campo Bandiera e Moro o de la Bragora
202	222	Dorsodoro	Campo S Margarita
203	113	Canaregio	Campiello de le Canne
204	136	Canaregio	Campo SS Apostoli
205	81	Castello	Campo S. Zacaria
206	203	Dorsodoro	Corte Vechia
207	189	Santa Croce	Campiello de le Strope
208	208	Dorsodoro	Campo S Trovaso
209	134	Canaregio	Campo S Sofia
210	132	Canaregio	Ruga Do Pozzi
211	153	Canaregio	Corte Corner
212	155	Canaregio	Campiello S Maria Nova
213	154	Canaregio	Campiello Bruno Crovato Gia' S Canzian
214	210	Dorsodoro	Campo S Trovaso
215	133	Canaregio	Ruga do Pozzi
216	84	Castello	Corte Correra
217	123	Canaregio	Campo S Marziale

Appendix K - Proposed Wellheads for New Uses

The following list shows all the wellheads we recommend for flower containers, sundials/wishing wells, and tourist maps.

Tourist Maps

Sundials

Flower Containers

Rizzi #	Sestiere	Location	Recommendation	Reason
1	San Marco	Piazzetta dei Leoni	Tourist Directory	Highly populated tourist area at southeastern end of Venice.
5	San Marco	Corte S Zorzi	Flower Container	Roots are not as harmful as concrete.
12	San Marco	Corte del Falcon	Flower Container	Roots are not as harmful as concrete.
19	San Marco	Corte Barozzi	Sundial/Wishing Well	Remote area with sun and several tourists.
20	San Marco	Corte del Teatro S. Moise	Sundial/Wishing Well	Remote area with sun and several tourists.
25	San Marco	Campo S. Anzolo	Sundial/Wishing Well	Remote area with sun and several tourists.
32	San Marco	Campo S. Vidal	Sundial/Wishing Well	Remote area with sun and several tourists.
35	San Marco	Corte Lezze	Sundial/Wishing Well	Remote area with sun and several tourists.
36	San Marco	Corte de le Pizzocare	Flower Container	Roots are not as harmful as concrete.
37	San Marco	Campo s. Anzolo	Sundial/Wishing Well	Remote area with sun and several tourists.
38	San Marco	Corte de L'alboro	Sundial/Wishing Well	Remote area with sun and several tourists.
39	San Marco	Corte Dei santi	Flower Container	Roots are not as harmful as concrete.
40	San Marco	Corte Barbarigo	Flower Container	Roots are not as harmful as concrete.
41	San Marco	Campiello Michiel	Sundial/Wishing Well	Remote area with sun and several tourists.
44	San Marco	Corte Contarina	Sundial/Wishing Well	Remote area with sun and several tourists.
45	San Marco	Corte Contarina	Flower Container	Roots are not as harmful as concrete.
47	San Marco	Corte Del Forno Vechio	Flower Container	Roots are not as harmful as concrete.
50	Castello	Corte De Ca' Bianco	Sundial/Wishing Well	Remote area with sun and several tourists.
53	Castello	Campiello de Cassarisina	Flower Container	Roots are not as harmful as concrete.
54	Castello	Corte De Le Colone	Flower Container	Roots are not as harmful as concrete.
55	Castello	Corte Formenta	Flower Container	Roots are not as harmful as concrete.
60	Castello	Corte Soranzo	Flower Container	Roots are not as harmful as concrete.
71	Castello	Corte Querini	Flower Container	Roots are not as harmful as concrete.
79	Castello	Campiello Del Vin	Flower Container	Roots are not as harmful as concrete.
83	Castello	Corte Rota	Flower Container	Roots are not as harmful as concrete.
89	Castello	Corte dei Orbi	Flower Container	Roots are not as harmful as concrete.
97	Castello	Corte Spechiera	Flower Container	Roots are not as harmful as concrete.
99	Castello	Corte Botera	Flower Container	Roots are not as harmful as concrete.
100	Castello	Corte Veriera	Sundial/Wishing Well	Remote area with sun and several tourists.
101	Castello	Corte del Peruchier	Flower Container	Roots are not as harmful as concrete.
102	Castello	Ramo Primo Brusa	Flower Container	Roots are not as harmful as concrete.
106	Castello	Corte Bressana	Sundial/Wishing Well	Remote area with sun and several tourists.
109	Canaregio	Campo S. Geremia	Sundial/Wishing Well	Remote area with sun and several tourists.
112	Canaregio	Campiello de le Scuole	Sundial/Wishing Well	Remote area with sun and several tourists.
115	Canaregio	Campiello Drio ca'Emo	Sundial/Wishing Well	Remote area with sun and several tourists.
118	Canaregio	Corte Erizzo	Flower Container	Roots are not as harmful as concrete.
120	Canaregio	Volto Santo	Flower Container	Roots are not as harmful as concrete.
124	Canaregio	Corte de la Rafineria	Sundial/Wishing Well	Remote area with sun and several tourists.
125	Canaregio	Campo dei Mori	Sundial/Wishing Well	Remote area with sun and several tourists.
130	Canaregio	Corte Pali Gia Testori	Tourist Directory	Highly populated tourist area in central Venice.
131	Canaregio	Campo de le Erbe	Flower Container	Roots are not as harmful as concrete.
132	Canaregio	Ruga Do Pozzi	Sundial/Wishing Well	Remote area with sun and several tourists.
135	Canaregio	Corte de la Pegola	Flower Container	Roots are not as harmful as concrete.
139	Canaregio	Corte de la Posta de Fiandra	Flower Container	Roots are not as harmful as concrete.
143	Canaregio	Ramo Del Tiziano	Flower Container	Roots are not as harmful as concrete.
144	Canaregio	Campiello del Pestrin	Sundial/Wishing Well	Remote area with sun and several tourists.
149	Canaregio	Corte Morosina	Flower Container	Roots are not as harmful as concrete.
153	Canaregio	Corte Corner	Sundial/Wishing Well	Remote area with sun and several tourists.
154	Canaregio	Campiello Bruno Crovato Gia' S Canzian	Sundial/Wishing Well	Remote area with sun and several tourists.
157	San Polo	Campo de le vecarie	Sundial/Wishing Well	Remote area with sun and several tourists.
163	San Polo	Corte Dei Preti	Flower Container	Roots are not as harmful as concrete.
166	San Polo	Corte Del Teatro Vechio	Flower Container	Roots are not as harmful as concrete.
182	Santa Croce	Campo Morto	Tourist Directory	Highly populated tourist area at northwestern end of Venice.
180	Santa Croce	Corte Seconda De Ca' Barbo	Flower Container	Roots are not as harmful as concrete.
195	Santa Croce	Porte Del Tagiapiera	Flower Container	Roots are not as harmful as concrete.
199	Santa Croce	Corte Dei Pontei	Flower Container	Roots are not as harmful as concrete.
200	Santa Croce	Corte Del Coregio	Flower Container	Roots are not as harmful as concrete.
203	Dorsodoro	Corte Vechia	Flower Container	Roots are not as harmful as concrete.
206	Dorsodoro	Piscina S Agnese	Flower Container	Roots are not as harmful as concrete.
212	Dorsodoro	Corte Canal	Sundial/Wishing Well	Remote area with sun and several tourists.
218	Dorsodoro	Corte S Marco	Flower Container	Roots are not as harmful as concrete.
224	Dorsodoro	Campiello De Ca' Bernardo	Flower Container	Roots are not as harmful as concrete.
225	Dorsodoro	Corte Dela Madona	Flower Container	Roots are not as harmful as concrete.
232	Giudecca	Corte Dei Cordani	Flower Container	Roots are not as harmful as concrete.

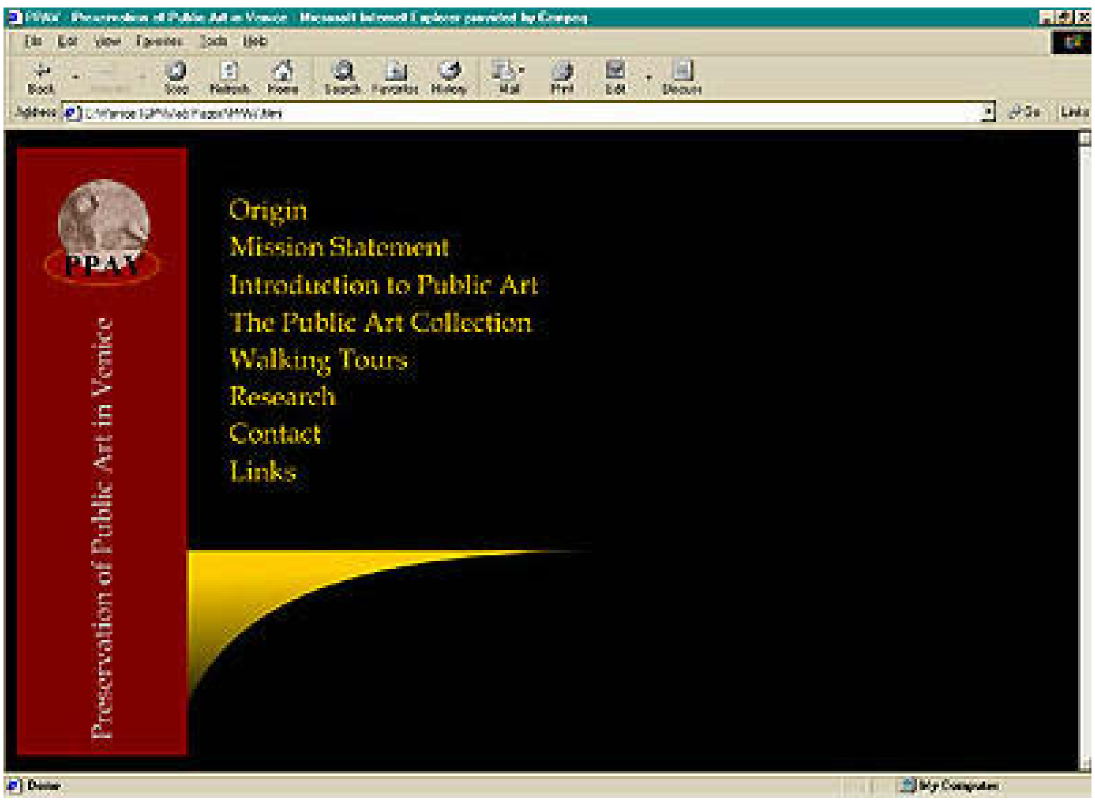
Appendix L - Web Pages

This appendix contains the home page that we created for the PPAV and also some recommended children's web pages.

L.1 PPAV Web Pages

Code and layout for the PPAV web pages

L.1.1 Home Page




```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN">

<html>
<head>
	<title>PPAV - Preservation of Public Art in Venice</title>
</head>
```

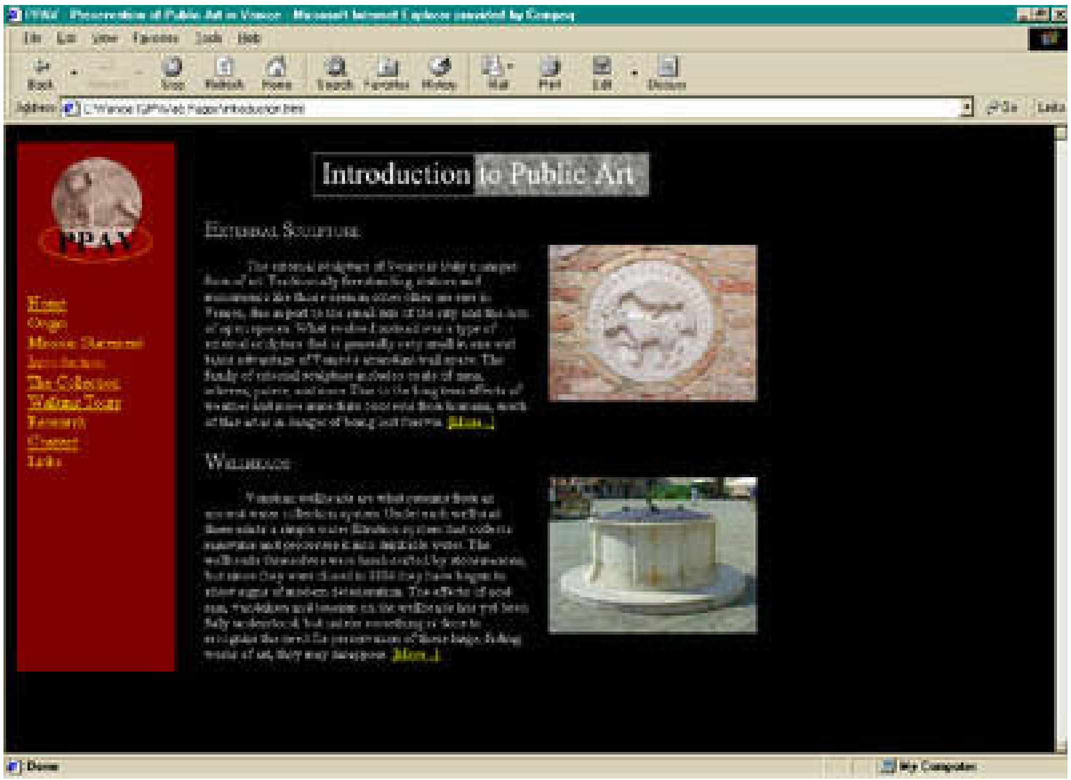
```
<body bgcolor="Black" text="White" link="Aqua" vlink="Blue" alink="Li me">
<table border="0" cellspacing="0" cellpadding="0">
<tr>
   <td width="160" rowspan="2" align="center" valign="top" bgcolor="Maroon"><br><br><img
src="PPAVlogo.gif" width=108 height=100 alt="PPAV" border="0"><br><br><br><img
src="sidetitle.gif" width=19 height=397 alt="Preservation of Public Art in Venice"
border="0"><br><br></td>
   <td>
<dd><table border="0" cellspacing="0" cellpadding="0">
<tr><td height="35" valign="top"><img src="origin.gif" width=73 height=25 alt="Origin"
border="0"></td></tr>
<tr><td height="35" valign="top"><img src="missionstatement.gif" width=207 height=18
alt="Mission Statement" border="0"></td></tr>
<tr><td height="35" valign="top"><a href="introduction.html"><img src="introtopublicart.gif"
width=290 height=19 alt="Introduction to Public Art" border="0"></a></td></tr>
<tr><td height="35" valign="top"><a href="collection.html"><img src="collection.gif" width=284
height=19 alt="Collection" border="0"></a></td></tr>
<tr><td height="35" valign="top"><a href="walkthisway.html"><i mg src="walkingtours.gif"
width=166 height=26 alt="Walking Tours" border="0"></a></td></tr>
<tr><td height="35" valign="top"><img src="research.gif" width=100 height=19 alt="Research"
border="0"></td></tr>
<tr><td height="35" valign="top"><a href="contact. html"><img src="contact.gif" width=86
height=18 alt="Contact" border="0"></a></td></tr>
<tr><td height="35" valign="top"><img src="links.gif" width=61 height=19 alt="Links"
border="0"></td></tr>
</table>
</td>
</tr>
<tr>
<td valign="top"><img src="platform.jpg" width=400 height=143 alt="| -------------------"
border="0"></td>
</tr>
</table>



</body>
```

```
</html>
```

L.1.2 Introduction to Public Art

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<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN">

<html>
<head>
        <title>PPAV - Preservation of Public Art i n Venice</title>
</head>

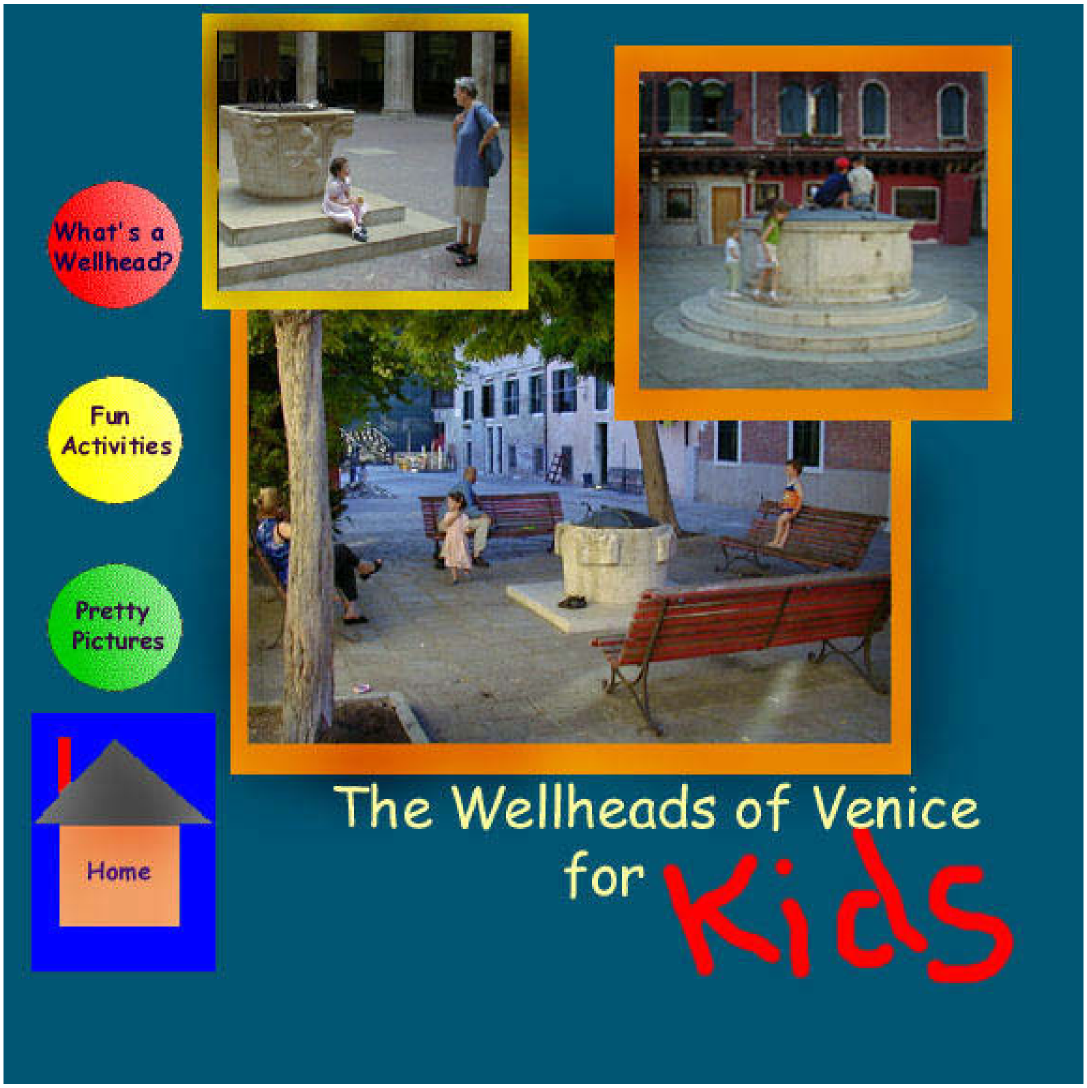
<body bgcolor="Black" text="Silver" link="Yellow" vlink="Yellow" alink="Gray">
<table width="740" border="0" cellspacing="0" cellpadding="0" bgcolor="Black">
<tr>
<td width="160" height="100" align="middle" valign="top" bgcolor="M  aroon"><br><img
src="PPAVlogo.gif" width=108 height=100 alt="PPAV" border="0"><br><br><br><table
width="130" border="0" cellspacing="0" cellpadding="0" align="center"><tr><td valign="top"
nowrap>
<font size="4" color="Yellow">
```

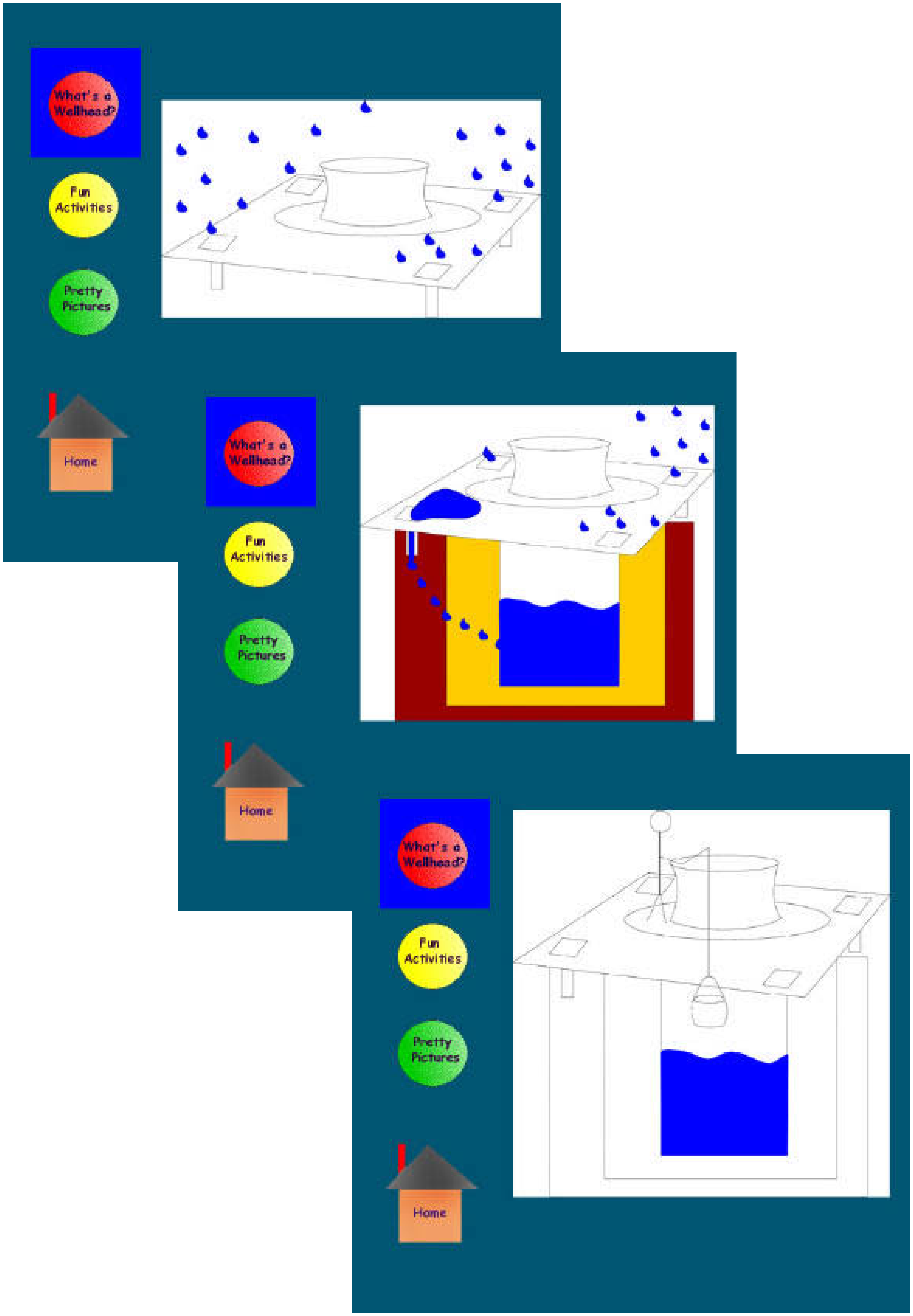
```
<a href="PPAV.html">Home</a><br>
Origin<br>
Mission Statement<br>
<font color="Orange">Introduction</font><br>
<a href="collection.html">The Collection</a><br>
<a href="walkthisway.html">Walking Tours</a><br>
Research<br>
<a href="contact.html">Contact</a><br>
Links<br>
</font><br><br><br><br><br><br><br><br>
</td></tr></table></td>
  <td width="600" rowspan="2" valign="top">

        <table width="550" border="0" cellspacing="0" cellpadding="10" align="center">
        <tr><td colspan="2" align="center"><img src="title_intro.gif" width=324 heigh t=43
alt="Intro to Public Art" border=0></td></tr>
        <tr><td width="350" valign="top"><font size="5">E</font>XTERNAL <font
size="5">S</font>CULPTURE<br><br>
<dd>The external sculpture of Venice is truly a unique form of art. Traditionally freestanding statu es and
monuments like those seen in other cities are rare in Venice, due in part to the small size of the city and
the lack of open spaces. What evolved instead was a type of external sculpture that is generally very small
in size and takes advantage of Ve nice's abundant wall space. The family of external sculpture includes
coats of arms, relieves, patere, and more. Due to the long term effects of weather and more immediate
concerns from humans, much of this art is in danger of being lost forever. <a
href="extsculpt_background/index.html">[More...]</a></dd>
</td>
<td><img src="extsculp_definition.jpg" width=200 height=150 alt="External Sculpture"
border="0"></td></tr>
        <TR><td width="350" valign="top"><font size="5">W</font>ELLHEADS<br><br>
<dd>Venetian wellheads are what remains from an ancient water collection system. Under each wellhead
there exists a simple water filtration system that collects rainwater and processes it into drinkable water.
The wellheads themselves were hand-crafted by stonemasons, but since they were closed in 1884 they
have begun to show signs of modern deterioration. The effects of acid rain, vandalism and tourism on the
wellheads has yet been fully understood, but unless something is done to recognize the need for
preservation of these large, fading works of art, they may disappear. <a
href="wellhead_background/index.html">[More...]</a></dd>
```

```
	</td><td><img src="wellhead_definition.jpg" width=200 height=150 alt="Wellhead"
border="0"></td></tr>
	</table>
	</td>
</tr>
</table>
</body>
</html>
```

L.2 Recommended Web Pages for Children



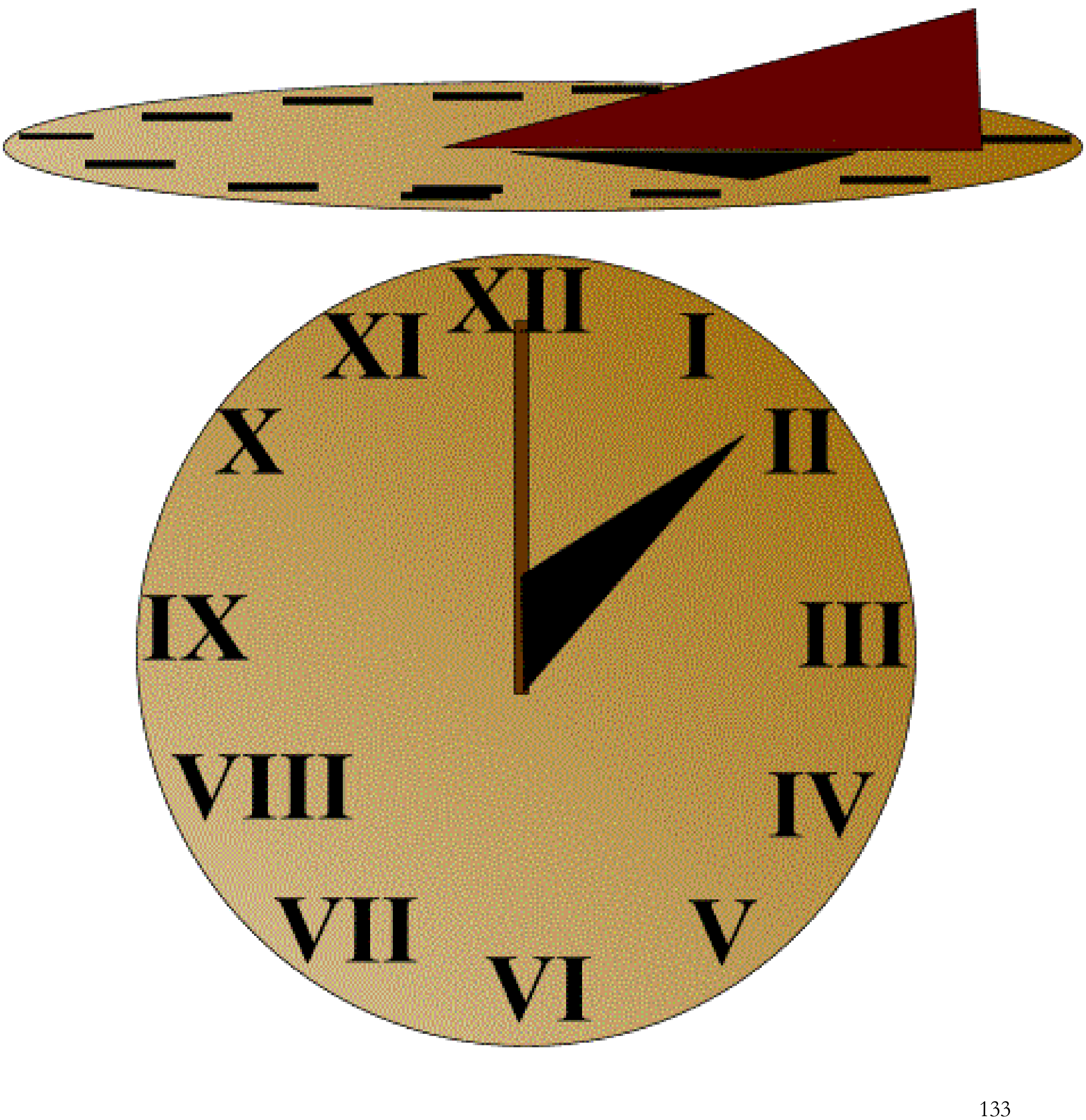

What's a Wellhead?
Fun Activities
Pretty Pictures
Home
What's a Wellhead?
Fun Activities
Pretty Pictures
Home
What's a Wellhead?
Fun Activities
Pretty Pictures
Home

Appendix M - New Uses for Wellheads Examples

In this appendix we give examples for new ideas for the lids such as sundials, and tourist directories.

N.1 Example of Sundials

These graphical representations are provided in order to demonstrate how a metal sundial might look.

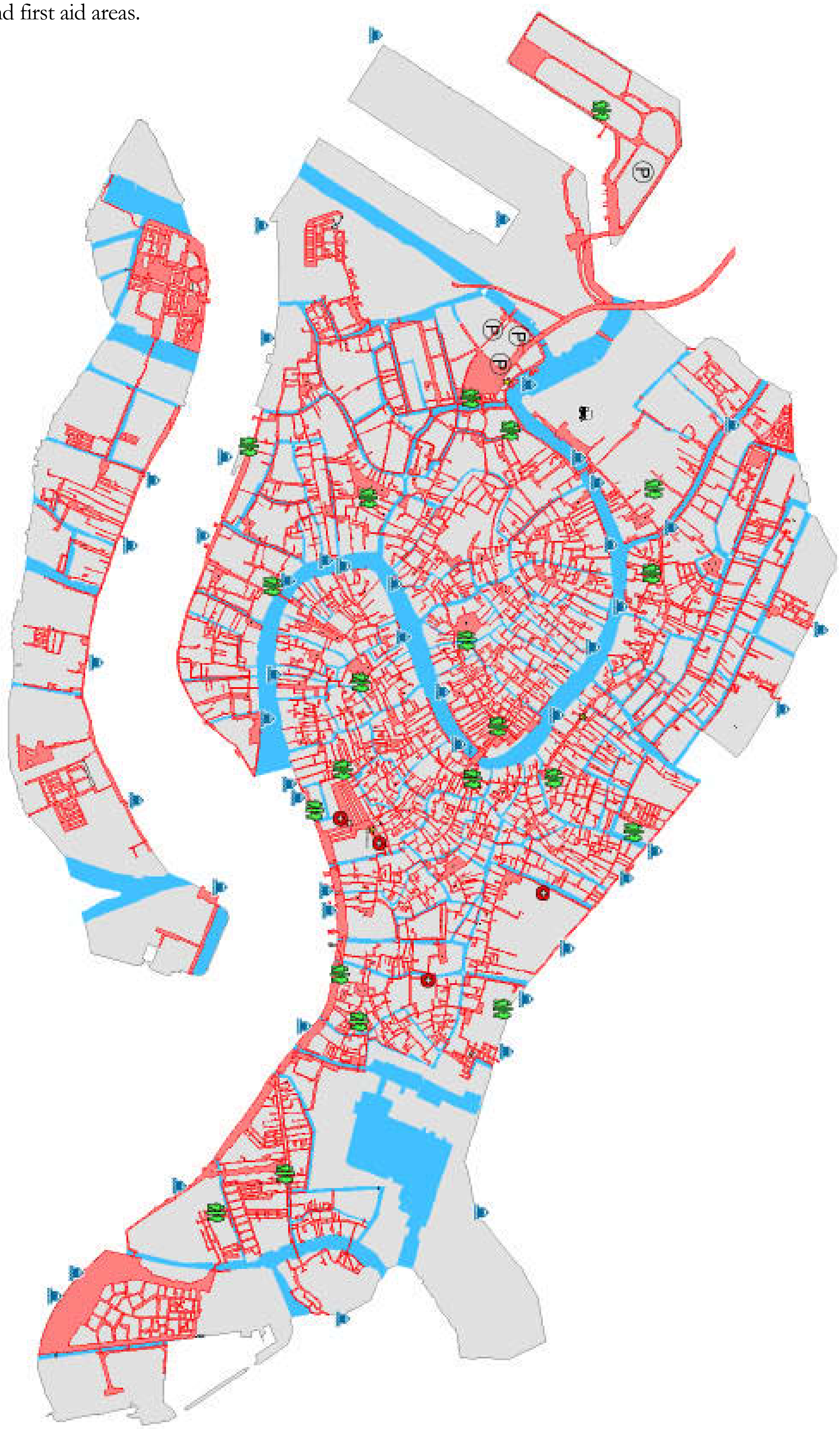


N.2 Example of Tourist Directory

This graphical representation is what we imagine our proposed wellhead tourist directories could look like.

N.3 Proposed Map for Tourist Directory

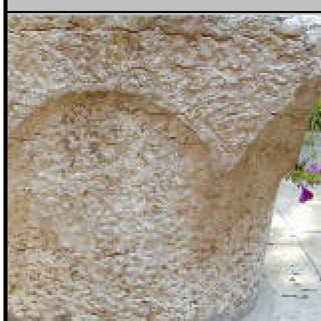
We recommend using a map such as this with all the streets, W.C's, parking lots, boat stops, train station, and first aid areas.



Appendix O - State of Conservation Illustrations

This appendix shows how to identify specific types of deterioration through illustrated examples.

	Accretions2	Paint accumulations usually caused by graffiti that obscures the surface of the wellhead completely
	Accretions1	Paint accumulations that are sporadic as in the edge of spray paint marks or tiny spattering that still allows the wellhead surface to be seen within it
	StructuralCracks	Any cracks which are deep into, or all of the way through the wellhead wall; potentially causing severe structural damage
	SurfaceCracks	Minor cracks located on the outermost surface of the wall

	Grime2	Grime, dirt, and sulfate accumulations that are pervasive to the point of completely obscuring the wellhead in coverage
	Grime1	Grime, dirt, and sulfate accumulations that are light enough to still see the stone surface
	SurfaceDamage2	Heavy damage to the surface; includes missing pieces
	Surface Damage1	Light damage to the surface; includes pitting, chalking and flaking
	Algae	Biological plant growth which slowly digests the stone and/or widens microscopic cracks causing damage

Appendix P - Translations for database

English	Italian	English	Italian
Angle of North Side	Angolo del lato del nord	Hand	Mano
Approximately	Circa	Height	Altezza
Area	Zona	Hexagonal	Esagonale
Arm	Braccio	Historic	Storica
Artistic	Artisitco	Inscription	Inscrizione
Base	Base	Iron structure	Struttura del ferro
Cap	Protezione	Leg	Piedino
Carving	Intagliante	Length	Lunghezza
Century	Secolo	Marble	Marmo
Chin	Mento	Material	Materiale
Circular	Circolare	Metal	Metallo
Circumference Of Base	Circonferenza della base	Mouth	Bocca
Cistern	Cisterna	Nose	Naso
Corner	Angolo	Popularity	Popolartia
Curved	Curva	Public Visibility	Visibilita
Diameter	Diametro	Rarity	Raro
Dimensions Drains	Dimensioni Vuota	Restoration Shape	Ripristino Forma
Ear	Orecchio	Side	Lato
Eye	Occio	Stone	Pietra
Face	Faccia	Top	Parte superiore
Feet	Piedi	Wellhead	Vera da pozzo
Flat	Piano	Written	Scritte

Appendix Q - Lid Replacement List

This Appendix contains a list of all the lids that we recom mend be replaced due to health hazards caused by rust and holes.

Appendix R - Prioritization List for Figures

This Appendix contains two lists for the prioritization of wellheads featuring figures. They show which wellheads are most in need of restoration or preservation, based only on the condition of their figures.

R.1 Considering "Gone" features

This list considers features that are "gone" as the highest priority for repair.

	Rizzi Number	Figure Deterioration Value	Location
1	69	0	Castello
2	120	3.5	Cannaregio
3	189	4	Santa Croce
4	81	4	Castello
5	66	4	Castello
6	205	4	Dorsoduro
7	207	4	Dorsoduro
8	210	4.5	Dorsoduro
9	221	5.5	Dorsoduro
10	95	6	Castello
11	61	6.5	Castello
12	108	8	Cannaregio
13	126	8	Cannaregio
14	141	8	Cannaregio
15	172	8.5	San Polo
16	74	9	Castello
17	182	9	Santa Croce
18	123	9.5	Cannaregio
19	18	10	San Marco
20	26	10	San Marco
21	90	10	Castello
22	114	10	Cannaregio
23	213	10	Dorsoduro
24	214	10.5	Dorsoduro
25	105	12.39285714	Castello
26	218	12.5	Dorsoduro
27	37	18	San Marco

R.2 Not Considering "Gone" Features

This list considers features that are "gone" as the lowest priority for repair due to the fact that they are virtually non-existent.

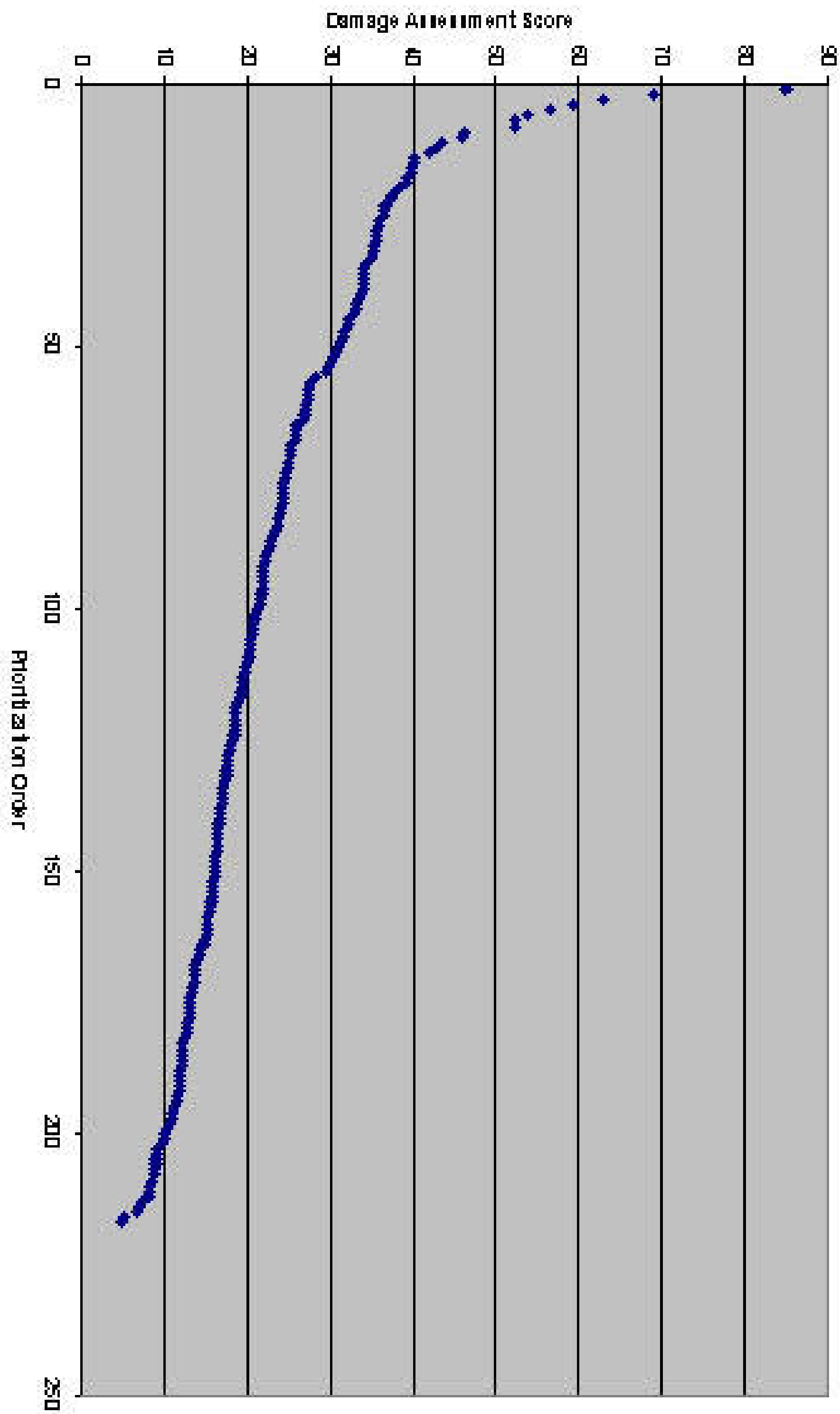
	Rizzi Number	Figure Deterioration Value	Location
1	189	7	Santa Croce
2	18	10	San Marco
3	120	11	Cannaregio
4	81	16.75	Castello
5	37	18	San Marco
6	172	19	San Polo
7	182	24	Santa Croce
8	108	26	Cannaregio
9	221	26.5	Dorsoduro
10	95	27	Castello
11	218	27.5	Dorsoduro
12	105	27.80357143	Castello
13	114	28	Cannaregio
14	214	28.5	Dorsoduro
15	123	29	Cannaregio
16	141	29	Cannaregio
17	126	29.5	Cannaregio
18	210	30	Dorsoduro
19	90	31	Castello
20	207	31	Dorsoduro
21	61	33.5	Castello
22	26	34	San Marco
23	213	34	Dorsoduro
24	74	36	Castello
25	205	37	Dorsoduro
26	66	40	Castello
27	69	42	Castello

Appendix S - Wellheads by Century

This Appendix includes a thematic map of all the public wellheads, displaying them by their approximated year of construction.

Appendix T - Damage Assessment Ranking

This graph shows the ranking of the wellheads by their damage assessment values only.



Appendix U - Effect of Importance Factors

This Appendix shows the effect the importance factors have on the final prioritization list.

	Without IF	With IF	RAU Score
1	**226**	**226**	**86.24316135**
2	**181**	**181**	**69.02934807**
3	**195**	**195**	**62.88007076**
4	**15**	**15**	**59.32310421**
5	**11**	**11**	**56.55012212**
6	**22**	**22**	**55.28961077**
7	**45**	**16**	**54.8939579**
8	**16**	**45**	**53.2734794**
9	**33**	**33**	**46.07925144**
10	**135**	**135**	**46.01472597**
11	**125**	**125**	**43.57620091**
12	**224**	**224**	**42.98202887**
13	**40**	**40**	**41.98188408**
14	**36**	**36**	**40.14290818**
15	**220**	**220**	**40.12677681**
16	**20**	**21**	**39.90028611**
17	**55**	**20**	**39.80414946**
18	**118**	**55**	**39.77188672**
19	**60**	**118**	**39.29601138**
20	**21**	**60**	**39.04597518**
21	**47**	**47**	**37.57802074**
22	**187**	**187**	**37.03761992**
23	**171**	**171**	**36.62627005**
24	**5**	**8**	**36.61784239**
25	**23**	**5**	**36.44075932**
26	**8**	**23**	**36.37623385**
27	**196**	**196**	**35.7067821**
28	**27**	**27**	**35.59386253**
29	**24**	**24**	**35.57773116**
30	**13**	**13**	**35.51320569**
31	**124**	**124**	**35.2067097**
32	**121**	**121**	**35.19057834**
33	**6**	**6**	**34.84375393**

34	**212**	**94**	**34.81112923**
35	**66**	**172**	**34.52685519**
36	**168**	**26**	**34.40784504**
37	**85**	**212**	**34.40014133**
38	**162**	**197**	**34.11748042**
39	**94**	**66**	**34.11246527**
40	**101**	**85**	**34.06138261**
41	**26**	**168**	**34.06138261**
42	**197**	**162**	**34.00492282**
43	**19**	**101**	**33.74682094**
44	**172**	**1**	**33.19734092**
45	**200**	**19**	**33.06123782**
46	**227**	**200**	**32.2089639**
47	**231**	**227**	**32.19014397**
48	**163**	**219**	**32.06073106**
49	**219**	**231**	**31.5345191**
50	**12**	**163**	**31.49649516**
51	**1**	**12**	**30.91576593**
52	**232**	**29**	**30.88314123**
53	**29**	**38**	**30.55244819**
54	**38**	**30**	**30.43031069**
55	**30**	**232**	**30.30546253**
56	**71**	**71**	**28.66522297**
57	**169**	**95**	**28.18113716**
58	**95**	**178**	**28.15694011**
59	**178**	**130**	**28.02498342**
60	**102**	**177**	**27.93378952**
61	**180**	**169**	**27.72982084**
62	**177**	**91**	**27.72103121**
63	**166**	**102**	**27.20555139**
64	**130**	**180**	**27.16522297**
65	**91**	**166**	**26.85066131**
66	**176**	**43**	**26.26164921**
67	**41**	**176**	**25.87471357**
68	**43**	**41**	**25.83438515**
69	**141**	**152**	**25.40639715**
70	**100**	**141**	**25.32624707**
71	**79**	**127**	**25.21296553**

72	**228**	**129**	**25.12424301**
73	**225**	**100**	**25.09234224**
74	**54**	**79**	**25.08427656**
75	**86**	**225**	**24.85037173**
76	**127**	**228**	**24.85037173**
77	**158**	**54**	**24.664861**
78	**10**	**86**	**24.47935028**
79	**129**	**158**	**24.28577386**
80	**152**	**87**	**24.277491**
81	**186**	**10**	**24.2696425**
82	**216**	**186**	**24.0680004**
83	**87**	**116**	**23.97034346**
84	**53**	**216**	**23.89862104**
85	**62**	**90**	**23.75307676**
86	**49**	**193**	**23.68048561**
87	**90**	**53**	**23.55179664**
88	**193**	**62**	**23.28562908**
89	**32**	**32**	**23.22880732**
90	**206**	**164**	**23.22866253**
91	**131**	**49**	**23.08398698**
92	**164**	**192**	**22.73680061**
93	**192**	**206**	**22.2774186**
94	**116**	**131**	**22.19676177**
95	**64**	**165**	**22.14800569**
96	**184**	**64**	**21.77734621**
97	**199**	**184**	**21.76928052**
98	**89**	**18**	**21.74047148**
99	**35**	**199**	**21.66980376**
100	**165**	**89**	**21.57570411**
101	**215**	**35**	**21.47891591**
102	**112**	**188**	**21.44283448**
103	**115**	**126**	**21.22059684**
104	**126**	**215**	**21.06756604**
105	**188**	**223**	**21.02956421**
106	**18**	**112**	**20.77720142**
107	**207**	**115**	**20.69116746**
108	**160**	**207**	**20.26099766**
109	**223**	**160**	**20.25293197**

110	**56**	**78**	**20.06705927**
111	**229**	**218**	**20.04031845**
112	**77**	**56**	**19.93030462**
113	**218**	**229**	**19.83351642**
114	**58**	**77**	**19.78512231**
115	**44**	**58**	**19.45442928**
116	**173**	**44**	**19.31731266**
117	**78**	**173**	**19.22859013**
118	**204**	**198**	**18.84914102**
119	**191**	**148**	**18.74414235**
120	**99**	**34**	**18.72009008**
121	**52**	**204**	**18.6478609**
122	**103**	**191**	**18.5994668**
123	**67**	**99**	**18.59140111**
124	**51**	**52**	**18.50805572**
125	**142**	**103**	**18.48654723**
126	**198**	**67**	**18.47848154**
127	**34**	**51**	**18.33329923**
128	**183**	**108**	**18.29440122**
129	**39**	**179**	**18.29260884**
130	**148**	**142**	**18.18811693**
131	**108**	**128**	**17.94578444**
132	**179**	**157**	**17.77640508**
133	**114**	**14**	**17.62315709**
134	**128**	**183**	**17.61545338**
135	**157**	**39**	**17.57512496**
136	**59**	**92**	**17.43764636**
137	**211**	**114**	**17.38961423**
138	**14**	**194**	**17.24406995**
139	**174**	**109**	**17.12286751**
140	**92**	**230**	**16.94527768**
141	**57**	**59**	**16.88147615**
142	**150**	**211**	**16.86534479**
143	**106**	**76**	**16.86469324**
144	**202**	**221**	**16.85691713**
145	**119**	**174**	**16.68789974**
146	**194**	**175**	**16.6230123**
147	**205**	**201**	**16.57058536**

148	**63**	**57**	**16.5104547**
149	**139**	**80**	**16.48589568**
150	**75**	**150**	**16.47012628**
151	**221**	**106**	**16.47012628**
152	**185**	**202**	**16.44592923**
153	**175**	**119**	**16.37333808**
154	**109**	**205**	**16.13136756**
155	**201**	**63**	**16.08297346**
156	**80**	**139**	**16.06684209**
157	**72**	**75**	**16.00231662**
158	**50**	**185**	**15.80874021**
159	**76**	**214**	**15.60342421**
160	**213**	**72**	**15.50224423**
161	**230**	**50**	**15.30060213**
162	**214**	**213**	**15.20220079**
163	**97**	**182**	**14.8808246**
164	**137**	**97**	**14.78439837**
165	**93**	**137**	**14.67954448**
166	**61**	**25**	**14.59852567**
167	**182**	**37**	**14.39666639**
168	**70**	**93**	**14.35691713**
169	**25**	**61**	**14.2063577**
170	**146**	**74**	**14.16283396**
171	**217**	**217**	**14.05826965**
172	**170**	**70**	**13.7277938**
173	**122**	**105**	**13.58606517**
174	**73**	**146**	**13.56648012**
175	**83**	**117**	**13.51750686**
176	**37**	**161**	**13.48008419**
177	**74**	**170**	**13.25191845**
178	**209**	**122**	**13.21159003**
179	**190**	**73**	**13.13899888**
180	**120**	**83**	**13.09060478**
181	**161**	**88**	**12.92907392**
182	**88**	**96**	**12.90473208**
183	**105**	**209**	**12.85669995**
184	**117**	**190**	**12.72764901**
185	**4**	**107**	**12.6950243**

186	**46**	**120**	**12.68732059**
187	**96**	**110**	**12.62243315**
188	**151**	**4**	**12.61451225**
189	**144**	**167**	**12.34013421**
190	**107**	**46**	**12.05013157**
191	**65**	**151**	**11.87268653**
192	**110**	**144**	**11.80816106**
193	**111**	**65**	**11.75976695**
194	**167**	**111**	**11.46133665**
195	**149**	**149**	**11.29195729**
196	**143**	**143**	**10.99083843**
197	**140**	**140**	**10.79995058**
198	**69**	**145**	**10.67061006**
199	**42**	**69**	**10.53378302**
200	**68**	**42**	**10.34827229**
201	**145**	**68**	**9.985316521**
202	**113**	**222**	**9.802132383**
203	**203**	**113**	**9.66268917**
204	**189**	**136**	**9.662327197**
205	**222**	**81**	**9.508862022**
206	**208**	**203**	**9.123901493**
207	**136**	**189**	**8.973073206**
208	**134**	**208**	**8.912580578**
209	**132**	**134**	**8.753955464**
210	**153**	**132**	**8.485099338**
211	**81**	**153**	**8.194734721**
212	**155**	**155**	**8.009223994**
213	**154**	**154**	**7.299443822**
214	**210**	**210**	**6.892126791**
215	**133**	**133**	**6.6138607**
216	**123**	**84**	**5.935836502**
217	**84**	**123**	**5.629630096**