Local Ecological Knowledge of Flooding in the Madison Valley Neighborhood of Seattle, Washington

by

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ABSTRACT

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A history of flooding in the Madison Valley neighborhood of Seattle, Washington dates back to the 1970s. The City of Seattle's Department of Public Utilities (SPU) is currently working on a long-term solution to this problem. Recent storms are the most intense on record and the flooding has been increasingly destructive. Local residents are extremely concerned that the long-term solution is effective. Local residents collectively hold a great deal of knowledge about the flooding problem based on years of first hand experiences. This research seeks to obtain the Local Ecological Knowledge of the flooding problem in an effort to supplement SPU's engineering analysis. The methods for this research included a review of community documents, historical research on the area, in-depth interviews with residents, and observation and participation in community meetings.

The results of this research provide evidence that Local Ecological Knowledge does exist in this urban neighborhood and that this knowledge is important in reaching a viable long-term solution. Specifically, the local participants were able to define the problem, highlight the main sources of the problem, and provide a variety of suggestions for the long-term solution that would increase the area's resilience to flooding. In addition, the Environmental Justice Paradigm provides a meaningful framework for understanding influences on this problem over time and today.

This Thesis for the Master of Environmental Studies Degree

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Acknowledgments

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CHAPTER 1 INTRODUCTION

December 14, 2006 storm event

After record rainfall in the month of November, a major storm hit the Puget Sound Region on December 14, 2006. Many areas throughout the region sustained great losses that night. The Madison Valley neighborhood of Seattle, Washington (Figure 1) was hit particularly hard by the rainstorm. Between 4:30 pm and 5:00 pm a torrential rain fell over the area, and the sewer and stormwater systems were quickly overwhelmed. As sheets of rain fell sideways, the residents of the Madison Valley neighborhood observed standing water rushing down steep streets, stairwells, hillsides, and yards. "It was flowing like rivers." The newly built one million gallon detention pond filled up quickly with runoff and overflowed into the streets and properties nearby.

Figure 1
Map of Madison Valley in Seattle. Adapted from Chris Goodman – History Link

The lowest-lying streets, alleys, and intersections filled with water, which poured into yards and belowground basements. Many residents' homes began taking on surface water before 5:00 pm and people came outside franticly to get help from neighbors. One resident whose basement ultimately filled up with five feet of water noted that "a great deal of water was observed… coming pouring, cascading down 31st, up over the parking strip, coming down the sidewalk, and

into the yard. I wasn't paying attention to my yard, because my neighbor was screaming for help, because their basement where they live was flooding."

Fire engine sirens blared loudly as people worked to unclog storm drains. By 6:00 pm many drains had been unclogged by residents and water started to drain out of the streets back into the pipes. Unfortunately, this exacerbated the problem for those whose basement sewer lines were backing up.

A windstorm followed later that night, knocking trees and power lines down all over the region. The power remained out in Madison Valley for approximately fifty-four hours. Many residents were outside walking around during this time, checking on each other, helping neighbors carry damaged items out of their basements, and sharing stories about what happened and what they knew of the flooding problem. It was not until later on the following day that I learned that one of my neighbors and acquaintances had died after being trapped in her basement. Though some Madison Valley residents were aware of three other situations where people were either pulled out or swam out of their flooded basements, the reality of this frightening outcome and the media attention it attracted helped the broader community to better understand the gravity of the flooding problem in the area. In the first couple days after the storm, many neighbors questioned whether they should move. One resident described the emotional stress experienced by people after the storm:

> It's not New Orleans, but sometimes it feels like a smaller version of that. It just goes on an on and on and you just want it to be over and to believe it will never happen again… But for so many people in the neighborhood, it was just a huge crisis. They had to go live in hotels, Christmas was coming and they had small children. You know our neighbors over here have two small children. They got divorced because of this storm. The first storm, because there was

> a lot of sewer-water downstairs, they had all the furniture and their whole lives up on the top two floors and they just got more and more stressed out by their living conditions. It totally screwed up their relationship and during this last storm they were just at the point where they are divorced now. The kind of stress it causes when you're trying to live your life, especially the people with children… I think of the heartbreak of Kate's death and at the same time I was feeling also the heartbreak of so many of the people living in this neighborhood who are really starting to worry about their property values. And there are… still a lot of pretty low-income people here. People that don't have very many assets or people who are planning on selling their house to finance their retirement or something like that. And there was just this sense of doom after this last flood… People were really depressed.

Purpose of Research

Fortunately, the following days also brought news that the City of Seattle Public Utilities Department (SPU) had been working on a long-term solution that would address the flooding in the neighborhood. At their public hearing on December 28, 2006 SPU explained that the interim solution to control combined sewer backups at 30th and East John Streets was two weeks from being completed when the December 14th storm hit, and that it was now completed. SPU answered questions from frustrated citizens and informed the crowd of four long-term solution options that they were considering. As the days passed, I spoke with many neighbors about their concerns over the flooding issue and what they thought was causing the problem. Many of the issues voiced did not appear to be under consideration by SPU's project. Thus, the purpose of this research is to obtain the local ecological knowledge of the flooding problem in an effort to inform SPU's long-term project planning. A secondary purpose of the research is to consider what the environmental justice paradigm can add to this analysis.

This research draws from six months of participation and observation in community hearings and meetings, reviews of community documents and newspaper articles, interviews with residents and government officials, walking and photo surveys of the area, and the benefit of having lived in this neighborhood for three years.

Significance

The water management problem in Madison Valley has been neglected since the1970s and some residents have been subjected to repeated stormwater and sewer backups on their property as a result. Now that the City of Seattle is taking action to resolve the problem, it is important that the experiential knowledge of the residents is heard and taken into account in selecting a long-term solution. This research contains narratives from the residents that can potentially help SPU better understand what has happened in the past and what the residents hope the long-term solution will provide for the future. In addition, it may help influence a solution that is more environmentally sustainable and democratic in a growing region. It also may have implications for future land use policies in this watershed and others as we plan for the more extreme storms that have started to occur in recent years.

CHAPTER 2 LITERATURE REVIEW

Local Ecological Knowledge

The terms "local ecological knowledge" and "traditional ecological knowledge" are used frequently in development and natural resource management discourses even though their definitions are debated (Ballard and Huntsinger 2006). The definition used here for *traditional ecological knowledge* is "a

cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans), with one another and with their environment" (Berkes, Colding et al. 2000). The term *local ecological knowledge* is used to refer to local expertise of residents who may not have a long-term relationship with the local environment, but nevertheless have local wisdom, experience, and practices adapted to local ecosystems (Berkes, Folke et al. 1998; Olsson and Folke 2001). *Conventional scientific knowledge* refers to science and management based on the traditions of Newtonian science and the expertise of government resource managers (Berkes, Colding et al. 2000).

Most traditional human cultures viewed themselves as a part of nature. Although a shift back to this traditional view is taking place, Western industrial societies have been the main exception to this worldview for the past four hundred years or so (Berkes, Folke et al. 1998: 9). Ancient cultures and indigenous peoples often have a longer-term relationship with their environment than others. However, this does mean that indigenous peoples have a monopoly over local ecological wisdom. There are cases of local, newly emergent, or new-traditional resource management systems which cannot claim continuity over thousands of years, but which are based on local knowledge and practice that is appropriately adapted to the ecological systems in which they occur (Smith and Berkes 1993).

In addition, there is ample evidence that the use of conventional scientific approaches alone in natural resource management has often been unsuccessful, and in many cases has exacerbated resource management problems rather than

solve them (Adams 1986; Chambers 1997; Holling, Berkes et al. 1998). One reason for this is that conventional scientific resource management had its roots in the utilitarian and exploitative worldview that assumes that humans have dominion over nature (Gadgil and Berkes 1991; McNeely 1991). Emerging literature notes the potential of using the ecological knowledge of local resource users themselves as a complement to scientific knowledge (Becker and Ostrom 1995; Berkes, Folke et al. 1995; Colding and Folke 2001; Nowotny, Scott et al. 2001; Ballard and Huntsinger 2006). This alternative paradigm for natural resource management is based on the premise that a participatory or community-based process, which integrates traditional and local ecological knowledge with conventional science, will better achieve sustainable natural resource use and biodiversity conservation (Huntington 1997; Sillitoe 1998; Berkes, Colding et al. 2000). Biophysical, socio-economic, and cultural/historical characteristics of the immediate environment also play a role in determining long-term sustainability. Thus, the knowledge of local residents is a valuable source of detailed information on the changes in these indicators over time (Duffington, Gardner et al. 1998).

The ability to adjust to changing environmental conditions is becoming increasingly important in a world of uncertainty and surprise (Gunderson 1999). Recent climate modeling results indicate that "extreme" events may become more common in the western U.S. as rising average temperatures produce a more energetic climate system (Tebaldi, Hayhoe et al. 2006). Current knowledge about responding to climate change tells us that adaptation will be necessary to address impacts resulting from the warming that is unavoidable from past emissions

(IPCC 2007). In addition, future vulnerability is influenced not only by climate change but also by non-climate stresses that reduce resilience and adaptive capacity. *Resilience* as defined here is the buffer capacity or the ability of a system to absorb disturbances and changing conditions (Holling, Schindler et al. 1995). A recent report assessing the impacts of climate change on Washington's economy notes that policymakers should prepare for the possibility that the economic costs of flooding in Washington will increase as temperatures warm and climate change proceeds (Bauman, Doppelt et al. 2006). In addition, local governments may need to reconsider design standards for stormwater collection systems, bridges, culverts, wastewater collection systems, wastewater treatment and other critical infrastructure in order to control the effects of higher volumes of storm-related runoff. Lastly, early efforts to estimate the costs and feasibility of retrofitting stormwater runoff and combined sewer overflow systems in urban areas will be important (Bauman, Doppelt et al. 2006).

The most recent reports from the Intergovernmental Panel on Climate Change note that sustainable development can reduce vulnerability to climate change (IPCC 2007). *Sustainability*, as defined by the World Commission on Environment and Development (WCED 1987), is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

In the effort to address uncertainty there are many proponents of adaptive management (Walters 1986). Local ecological knowledge is inherently adaptive in its emphasis on interpreting and responding to feedbacks from the environment that signal a need for change in management responses. Traditional survival

depended on this intimate understanding of place and ability to adapt. An *Adaptive Management* approach today explicitly recognizes the existence of uncertainty, documents hypotheses about the response of ecological systems to management intervention, monitors actual responses, and adjusts to management actions over time, rather than using existing knowledge and predictive models to select a single "best" fit plan (Failing and Horn 2004). Adaptive management addresses the unpredictable interactions between people and ecosystems as they evolve together. Recognition of the importance of experiential knowledge is the basis of the paradigm of adaptive management of complex ecological systems (Holling 1978; Gunderson, Holling et al. 1995). For adaptive management to work, knowledge and understanding of complex ecosystem dynamics needs to become embedded in a network of institutions that can interpret and respond to environmental feedback (Holling, Berkes et al. 1998).

Urban Stormwater Management

Cities throughout the world are faced with stormwater management challenges. *Stormwater overflows* take place during heavy rains when the utility piping systems that transport water to sewage treatment facilities are not big enough to handle all the water entering, and water consequently backs up. Traditional scientific methods for dealing with stormwater have not been successful for a variety of reasons and a more adaptive approach is recommended for urban stormwater management (Wanielista and Yousef 1993).

Cities typically have a mixture of infrastructure for urban drainage and water pollution control. These various systems were conceived at different times, planned with different philosophies, designed according to different criteria, and

built to operate differently. Thus, it is not surprising that as complete systems, utility infrastructures have many problems, which require not one solution, but a set of solutions. It is characteristic of larger North American cities that both combined sewer and stormwater systems and separated sewer and stormwater systems service a city. Typically, combined systems are found in the older and more densely built urban core, while separated systems are found in more recently developed areas (Adams and Papa 2000).

Two problems related to the operation of combined sewer systems are the occurrence of combined sewer overflows and the occurrence of combined sewer surcharge conditions resulting in sewer backup or flooding. Although the sewer backup problem is not directly related to water quality problems at receiving water bodies, it is indirectly related as the remediation of sewer backup problems may compete with the remediation of water quality problems for funding (Adams and Papa 2000).

An understanding of the principles and concepts of hydrology and hydraulics is very important for the design and operation of stormwater management systems. *Hydrology* is the study of waters and their occurrence on, above, and below the earth's surface. Methods to quantify the hydrologic processes of precipitation, evaporation, transpiration, rainfall excess, runoff, and infiltration should be known if we are to control flooding and pollution problems in a technically efficient way. The study of *hydraulics* aids in explaining and quantifying the movement of waters on or below the surface. The engineering aspects of stormwater management also require an examination of the economic, social, and political impacts of all projects. Thus effective stormwater

management requires an interdisciplinary body of knowledge for planning, design, and operation (Adams and Papa 2000).

The engineering for the Madison Valley project is extremely complex due to the steepness of the hillsides, the broad area of the drainage basin, and the fact that the area is heavily paved and densely developed. In addition, social and environmental factors have played a part in how utility infrastructures have been implemented over time and will continue to do so. Due to the inconsistent nature of stormwater management throughout history, it would be valuable for the local residents to have a better understanding of the existing infrastructure in their neighborhoods, so that they can provide input based on their intimate knowledge of the area.

Environmental Justice

The environmental justice paradigm can provide an important framework for considering how the flooding problem in Madison Valley affects local residents and how SPU can connect social and environmental issues to its current project. "*Environmental justice* can be understood as a local, grassroots, or "bottom-up" community reaction to external threats to the health of the community, which have been shown to disproportionately affect people of color and low-income neighborhoods" (Agyeman 2005). A major influence on the environmental justice movement is the issue of waste. The economy of the United States developed rapidly and the immense production that takes place requires a large amount of land for waste (Bryant 1995). Taylor notes that middle class Whites and then working class Whites mobilized first to maintain the integrity of their living communities by using zoning laws, legal challenges, and

other means. As a result, industry and governments responded by identifying areas where there would be less resistance to Locally Unwanted Land Uses, and these areas were often in people-of-color and low-income communities (Taylor 2002).

The landmark 1987 United Church of Christ study "Toxic Wastes and Race in the United States" found that certain communities, predominantly communities of color, are at disproportionate risk from commercial toxic waste. This finding has been confirmed by later research (Bullard 1990; Bryant and Mohai 1992; Goldman 1993). Some positive actions to address the environmental injustices occurring in people-of-color-communities were 1) the First National People of Color Environmental Summit in 1991 and the resulting formation of the principles of environmental justice, 2) the formation of hundreds of environmental justice organizations in the 1990s that influenced corporate behavior, and 3) President Clinton's Environmental Justice Executive Order in 1994, which mandated that agencies like the EPA incorporate environmental justice considerations into their operations. This led to the EPA's interim guidelines to identify cases where disproportionate impacts from exposure to pollution were present and also to the creation of offices and staff positions to deal with environmental justice issues (Taylor 2002).

The environmental justice movement has expanded the dominant traditional environmental discourse, based around environmental stewardship, to include social justice and equity considerations. In doing this, the *environment* takes on new meaning. It is no longer just the wilderness, but "where we live, where we work and where we play" (Alston 1991). The environmental justice

movement has been effective at addressing issues of poor people and people of color, who are disproportionately affected by environmental "bads" such as toxic facilities, poor transit, and increased air pollution and who have restricted access to environmental "goods" such as quality green spaces (Agyeman 2005).

Cole and Foster warn that the tendency to look for individual bad actors obscures the forces at work in producing environmental racism by disaggregating communities and institutions and isolating them from their social settings (Cole and Foster 2001: 12). For a broader causal analysis and understanding, they explain that we must look at the political economy of distributional outcomes. This is meaningful since there are so many different factors that come into play when a community is being exposed to more than their fair share of hazards. A major policy level achievement of the environmental justice movement has been its critique of expert-led processes in both risk assessment and research and its ability, with help from those in allied movements such as health, to shape more transparent, accountable, and democratically informed processes (Agyeman 2005).

Agyeman contributes to the environmental justice movement with the Just Sustainability Paradigm (JSP) (Agyeman 2005). He believes that the sustainability and environmental justice movements need to be bridged in order to be more effective in reaching the goals of both. "If sustainability is to become a process with the power to transform, as opposed to its current environmental, stewardship, or reform focus, justice and equity issues need to be incorporated into its very core" (Agyeman 2005: 6). The following history section will provide

details that link flooding in Madison Valley to the environmental justice framework.

CHAPTER 3 BACKGROUND

History

The neighborhood known today as Madison Valley is centered on the corner of E. Madison Street and Martin Luther King Jr. Way E., which represents the intersection of the main thoroughfares and the location of the business district. This neighborhood name and its geographic demarcations were established fairly recently. Thus, the following history is compiled from references to areas that fall under the neighborhood's current boundaries. The history is by no means comprehensive, but represents landscape transformations, people, and events that appear to have been integral in influencing what the area is like physically and socially today.

1. Seattle

A brief environmental history of Seattle describes the social and physical characteristics of Seattle that influenced the major environmental changes that took place after Euro-American settlers arrived in Seattle in 1851 (Klingle 2001). In cities with a great deal of water, attempts to improve upon nature with city infrastructure have been very challenging (Klingle 2001: 14). The first Euro-Americans saw the landscapes that would become Seattle from the sea. These travelers saw the region's watery terrain as both a blessing and a curse, and the first permanent colonists attempted to divide water from land in order to help the area grow into a big city and to insure proper functioning of the city (Klingle 2001: 20-21).

Beginning in the 1880's residents and outsiders improved and standardized the city's diverse wetlands to reduce flooding, reclaim lands, and build industry. These practices were in direct contrast with the Indian stories of the landscape, which reveal how they organized their lives to match the rhythms of the rivers rising and falling, the tides ebbing and flowing, and the lands submerging and reemerging. In many areas of Seattle, humans have re-structured nature's plumbing by straightening rivers to control flooding. Over time, the salmon born in the small creeks that drained into Lake Union found their waterways paved over and converted into storm drains (Klingle 2001: 25).

In the early days of Euro-American settlement in Seattle, only an elite group of people made the decisions about which areas of the young city would be transformed. From the 1850's through to the early 1900's, residents of Seattle toiled to solidify the boundaries between land and water. Out of these struggles with water, Seattle's spatial problems were recast as social and technical challenges best solved by trained experts (Klingle 2001: 16).

2. Madison Valley

The last of the great glaciers, *The Vashon*, shaped Seattle's Lake Washington neighborhoods, including Madison Valley, approximately 10,000 years ago (Rochester 2001). Historically, the low-lying section of Madison Valley was the bed of a salmon stream which flowed via a gully north to Union Bay in Lake Washington through what is now the Washington Park Arboretum. The stream crossed today's East Madison Street at 30th Avenue East. This was the natural drainage route for the drainage basin (Seattle 1975). The Duwamish tribe were the indigenous people of metropolitan Seattle and they used the low-

lying area of Madison Valley as hunting, fishing, and gathering ground, while their seasonal camps were at various locations along the shores of Lake Washington (Rochester 2001). They were forced off this prime land in 1856 (www.accessgenealogy.com/native/tribes/salish/duwamishhist.htm 2007).

Two early residents shaped the physical layout of what is known today as Madison Valley. The first was Judge John McGilvra who settled 420 acres near Madison Park in 1864 (Hitchman 1967: 7). McGilvra moved to the Washington Territories after President Lincoln named him United States District Attorney for the Washington Territory. McGilvra's influence on the area comes from the housing he helped create and the recreational facilities near Lake Washington he developed which brought people to that end of town. At the time McGilvra purchased property near Lake Washington it was considered far outside of the city. To provide a connection to town and to promote his real estate development, McGilvra spent $1500 from 1864-65 to clear and construct the Lake Washington Wagon Road from town to his property on Lake Washington (Greenblat 1997). Today that former wagon road is known as E. Madison Street. This road became a popular by-way for summer visitors as Madison Park grew to be a vacation destination. Due to increased activity on the road, McGilvra started a cable railway company and built a trestle through the core of Madison Valley in 1889 that ran over the salmon stream and gully and headed to the shores of Lake Washington (Bagley 1916). Stagecoaches ran from Elliott Bay to Lake Washington every two minutes in the summer time (Kim 2001).

The next major settler to the area was William Grose who bought twelve acres from Henry Yesler in 1882. Born in Washington D.C. in 1835, he was the

son of a free Black restaurant owner. Grose moved to Seattle via California and British Columbia in 1861 and his wife Sarah and two of his children followed soon after (Taylor 1994). After working initially as a cook in local establishments, he bought property, built rental houses, and owned and operated Our House restaurant and hotel in downtown Seattle. The twelve acres he bought for $1000 in gold spanned from 23rd Avenue to 27th Avenue and from Olive St. to Howell St. Although the wagon road had been cleared over twenty years earlier, the northeastern end of the city where Grose bought his land was still mostly undeveloped and heavily forested until the Madison Cable Railway was added in 1889. Bears inhabited part of the forested area during this time as well (Mumford 1980).

Mr. Grose used his property as a ranch and continued to live downtown until the fire of 1889 destroyed his hotel. After the fire, he moved his family to the ranch and he and his son George operated a truck farm. After moving to E. Madison St. William Grose, (and after his death, George), began selling land to other Black families, which resulted in the development of Seattle's first stable, working class African American neighborhood (Mumford 1980). By 1900, with the largest concentration of Black homeowners, the emerging African American middle class aspired to live and own in East Madison (Taylor 1994). America's entry into World War I (1917-1919) encouraged new, modest housing to be built in Madison Valley for the influx of shipyard workers (Rochester 2001).

The following oral history provides anecdotal memories of the stream and the beginnings of the community that settled what is now known as Madison Valley:

> [T]here was several streams of water that came up from Lake Washington… well, all the streams that came up as we knew 'em, they came up through and they went into Lake Washington, that is draining from the City of Seattle. And there was one that came through the Arboretum… then. It still does, but it's underground in… oh, a five foot concrete pipe now. And it came up down in through where… East Madison; at the time they called it Coon's Hollow. And the reason they called it that, there was a enterprising fellow here name Presto. And he turned himself into a… got a job as a land salesman, one of the big companies at the time. And he plotted - the company did - platted this all down in that East Madison district, they plotted that out into lots. That used to be, oh three or four farms down there. And they plotted that out into lots, and he had the job selling those lots. Well, then he went around and knocked on the door of every minority person in Seattle that had a dark face and tried to sell 'em lots down there. And they bought lots and started buying, building houses down there. And… so it was 99% minorities lived down there… And this here stream run up through there and it was quite a little stream. It run up through there, oh, it run up around to where… East Union Street is now. And the salmon would come up there, and we would go down there with our bicycles, and had a pitchfork and a gunnysack. And we had a little bulls-eye lantern. …And it showed a pretty good light, and we would shine that in the water. And we'd see one of these salmon coming along and we'd take the pitchfork and spear 'em and take 'em out… and put him in the sack. And when we got four or five of those salmon in the sack, why then we'd… tie it on to the front of our bicycles and then go on back. Go home" (Moss 1975).

As a result of the valley becoming more developed, a 54-inch sewer line was constructed down the route of the gulley and continued to the Montlake District. This is the combined trunk sewer which serves this area at the present time (Seattle 1975). In 1915, with the passing of the cable car era, a land-fill was created across the gulley in an effort to replace the Madison Street trestle and form what would become the permanent automobile road (Seattle 1975; Taft 1993). The landfill effectively dammed the natural drainage route. The salmon stream dried up and the remaining trickle of water was routed through a pipe to the Washington Park Arboretum (Rochester 2001). The elevated road also

blocked Madison Valley residents from being able to walk directly to the wild growth that would later become the Washington Park Arboretum (Rochester 2001).

In 1923 informal covenants prevented Blacks from buying property north of E. Madison St., which soon led to formal covenants restricting the selling of property to Blacks in many sections of the city (Mumford 1993). The 1940s were a tough time for Madison Valley as the area was in economic decline. There were neighborhood brothels and some homes sat empty. The turmoil of the 1960s and 1970s was felt here and with the "white flight" to the suburbs during these years, Madison Valley remained primarily an African American neighborhood. The headquarters of the Black Panther movement was just ten blocks away in Madrona (Rochester 2001).

3. Forward Thrust

On February 13, 1968 voters in King County approved Proposition 6, a bond proposal also known as Forward Thrust. Forward Thrust was a major works program with bond proposals for parks, transportation, community housing, water issues, and more (Burrows 2003). Forward Thrust sewer separation bonds totaling $70,000,000 were made available to finance storm and sanitary separation projects for areas of Seattle which had problems with sewer backups, overloaded combined sewers, and overflows to beaches and water bodies. Eighteen thousand acres of land in Seattle were designated for this project. Lake Washington North was the name of the project in the Madison Valley drainage basin, which reportedly covered over one thousand acres and was isolated from the nearest receiving water body (Lake Washington) by a high ridge on the east and the

Arboretum on the north (Seattle 1975). The Draft Environmental Impact Statement (DEIS) for Lake Washington North Unit 1, Contract 2, Harrison Street Tunnel (1975) notes that the first steps had already been taken towards sewer separation in Lake Washington Unit 1. The two completed areas were temporarily being discharged into the existing combined trunk sewer line at 30th and East John. Further separation contracts could not proceed until a method of transporting the storm water already collected and the additional amount anticipated from the remaining contract areas to Lake Washington was developed. The preferred alternative in the 1975 DEIS would have tunneled stormwater to an outfall in Lake Washington via Harrison Street at an estimated cost of $3,600,000.

Other alternatives were considered in this DEIS, including a drainage route through the Arboretum via a long pipe or through the natural drainage channel, which would have required alterations to the existing streambed. The estimated cost for this alternative was $4,525,000, but public sentiment against disruption of the Arboretum combined with the studies being conducted on minute organisms found in the streambed essentially precluded the use of any route through the Arboretum.

Another alternative analyzed in the DEIS was a 5.5 acre holding basin, which would be located west of the Martin Luther King School, bounded by East Republican Street on the north, East Harrison Street on the south, Dewey Place on the west and 32nd Avenue East on the east. The environmental impacts for this alternative were high as well due to the need to remove 40 homes and find equivalent housing for those households. A noted positive of this alternative was that if there was ever a need to treat stormwater runoff before allowing it to

discharge into the lake, this receiving basin would provide a practical location for accomplishing this. An ongoing loss of $14,000 to $20,000 per year from the lost taxes on the homes was forecasted. This alternative was expected to cost $3,600,000 (Seattle 1975).

The DEIS considered the Do Nothing alternative and stated that:

> Without a storm outfall for the system, there is a possibility that there could be backups and flooding on the combined sewers upstream from the new temporary connection at 30th and East John which must be used until the outfall system is activated. This inaction would nullify the will of the voters who authorized the project of sewer separation (Seattle 1975).

The primary goal of this project was to upgrade the quality of the lake by removing stormwater from the combined sewers and in turn reduce the number of overflows of combined sewage into the lake (33).

It is unclear exactly why this project was never completed. An unofficial Madison Valley question and answers letter from SPU to the flood victims in 2004 reports that this segment of the project was rejected by Seattle citizens because it was too expensive. Environmental concerns over the health of Lake Washington have also been noted (S.P.U. 2005). At the Greater Madison Valley Community Council meeting on February 21, 2007 City Councilmember Richard Conlin stated that a failed bond measure was the reason the project was not completed.[1]

It would be valuable to know when this vote did take place and what it was competing with, but regardless of that information, the outcome of the initial

[1] A public disclosure request to the City Clerk's office was made in March 2007 to find out more information on the failed bond measure that precluded the finishing of the stormwater separation project at 30th and East John Streets, including the date and possibly the financial extent of the bond. No response was received.

phase of the drainage separation project in 1973 created a scenario where stormwater is conveyed to the valley floor very quickly. The only discharge from this area during storms has been a 60" Combined Sewer (CS) line which does not have sufficient capacity to convey stormwater and wastewater from the basin north to the Arboretum and the King County CS line (S.P.U. 2005). As a result, stormwater and sewage has backed up into streets, yards, and basements since the 1970s on average every four years (S.P.U. 2005). The repeated backups and flooding and the severity of the more recent storms have resulted in the community's loss of trust in the City to provide basic services (S.P.U. 2005).

4. Current SPU Project

Due to this history of flooding and a large storm on August 22, 2004, Mayor Greg Nickels and Seattle Public Utilities (SPU) committed to implementing a project that would address the inadequate utility infrastructure in this area. On December 28, 2006, SPU completed the interim solution phase of their project. The interim solution condemned five properties and created a one million gallon detention pond. In addition, flow control gates were installed to direct stormwater into the pond rather than the CS line until there is enough room in the CS line to drain the pond. Unfortunately, this phase was two weeks from completion when the December 14, 2006 storm hit, so the CS line at 30th and East John backed up again. The one positive outcome of the December 14, 2006 storm is that it provided SPU's project engineers with needed volume and flow data for their analysis and modeling of the long-term solutions to the utility problem.

The drainage area in Madison Valley is approximately 790 acres (CH2MHill 2007). Long-term solutions are currently under review by SPU (Figure 2). The preferred alternatives that were presented during the December 28, 2006 community hearing have changed a bit as a result of further analysis based on the December 14, 2006 storm event as well as meetings with other government agencies (ESC 2007). An alternative previously called Alternative B was taken off the preferred list after the engineers learned that King County's Combined Sewer line under the Washington Park Arboretum reached capacity during the December 14, 2006 storm. The fact that the King County line

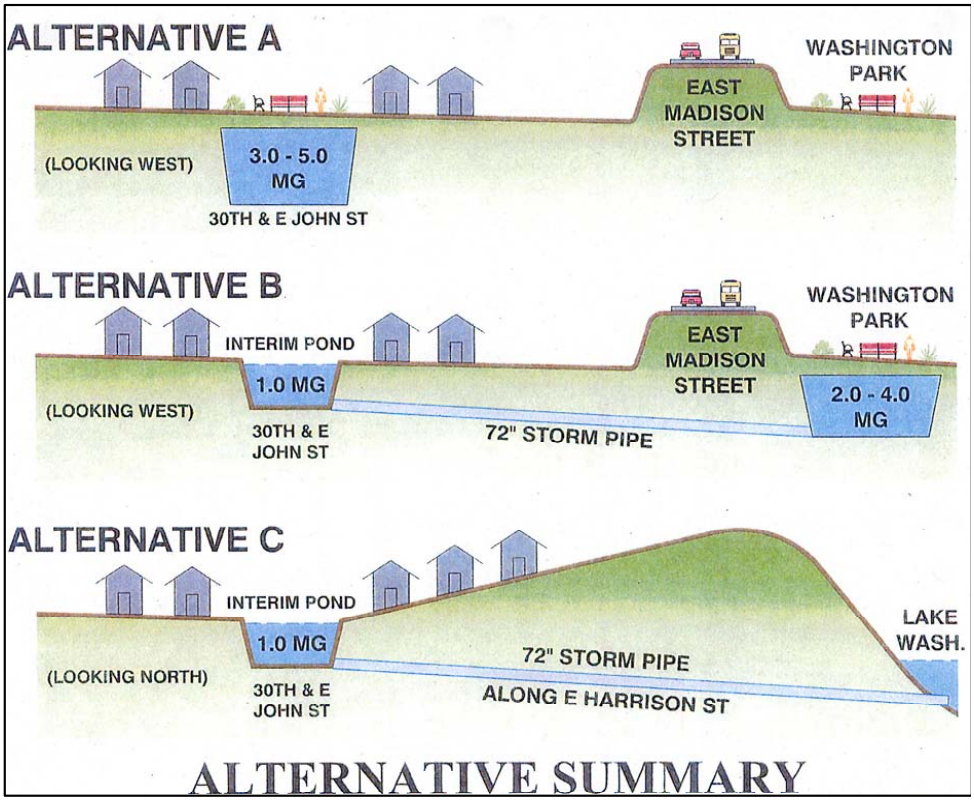

Figure 2. SPU's Preferred Long-Term Solution Alternatives. **Alternative A** represents a covered tank in place of the current detention pond area at 30th & E. John. **Alternative B** represents a conveyance pipe from the existing detention pond to an underground tank at Washington Park. **Alternative C** represents a conveyance pipe from the detention pond to Lake Washington. Adapted from Seattle Public Utilities.

surcharged on December 14, precludes any long-term solution that would convey additional stormwater from Madison Valley directly into the King County line during a storm (S.P.U. 2005).

Alternative C, which entails tunneling stormwater along Harrison Street directly to Lake Washington, was added to the list of alternatives after the December, 14, 2006 storm. However, this alternative is much more expensive and time-consuming due to regulatory requirements at the state and federal level. In addition, there are challenges to getting the majority of the stormwater into the conveyance pipe. As a result, at the May 31, 2007 SPU reported that they do not think it represents a viable long-term solution alternative (ESC 2007). In May 2007, SPU completed the computer model they will use to analyze the options and are currently considering Option A and Option B. In addition, they are considering the benefits of diverting the Northwest lobe of the drainage basin north to Washington Park, so that there is less stormwater coming to the combined sewer line at 30th and East John (See Figure 6)**.**

Principal Stakeholders

It is important to identify the stakeholders in a project like this to get an understanding of who SPU and the Madison Valley community will need to negotiate with in order move forward with a long-term solution. The following list represents the stakeholders of which I am aware. There is some overlap of members within these groups.

1. The Madison Valley residents are a primary stakeholder due to damage and losses in their homes and property from the CS line backups and the

excessive surface street runoff mentioned above. An effective solution to the problem is vital to the well-being of the community.

2. Seattle Public Utilities is the agency working on the long-term solution and is responsible for studying engineering feasibility and obtaining the land, permits, and funding for the project.

3. An organized group of flood victims who have made claims for damages are known as the Madison Valley Victims Association (MVVA). This group formed after the August 2004 storm and continues to meet to support each other, share information regarding the claims process, and consider their legal options. Members of this group have expressed a loss in the value of their homes due to the flooding problems.

4. The Madison Valley Engineering Sub-Committee (ESC) formed upon request by the community as a result of the loss of trust in the City. This group consists of SPU and community representatives and the meetings are open. In regularly scheduled meetings, the SPU project team provides progress updates and the community members provide feedback as representatives of the neighborhood. John Frech of BHC Consultants was previously the community liaison employed by the City to provide an independent opinion and engineering translation to the community representatives. As of May 10, 2007 John Frech had to step down from this position and the new community liaison is John Rogers of CH2MHill (ESC 2007).

5. The Seattle Parks Department is a stakeholder since the long-term alternatives under consideration involve a detention tank and/or conveyance pipes to be built under the soccer field at Washington Park.

6. The Washington Park Arboretum is a stakeholder as it represents the historic natural drainage for Madison Valley, which some would like to see restored.

7. King County Public Utilities is a stakeholder as SPU's CS lines feed into the King County CS line located under Washington Park. The King County CS line then runs northwest to West Point Treatment Plant where the combined storm and sewer water is treated before being released into Puget Sound.

8. The Greater Madison Valley Community Council (GMVCC) is the local neighborhood association. They hold monthly meetings where residents of the area have historically expressed concerns, which are on occasion conveyed to City leadership by letter. The group uses the Valley View newsletter as its main mode of communication with residents today. The members all volunteer their time.

9. Greg Nickels, the mayor of Seattle, and the City Council members have political power in Seattle and thus are stakeholders as well.

Influential policies

There are many policies that come into play in the analysis of a long-term solution to the flooding in Madison Valley. Some of the following policies have been mentioned in meetings with SPU. Some are policies that I or other Madison Valley residents believe influence the problem and should be considered in the long-term solution of the flooding problem. Undoubtedly, there are many additional policies and regulations that affect SPU's long-term solution analysis and implementation of which I am not aware.

First, SPU has a *Wastewater Comprehensive Plan* with a drainage and wastewater level of service that strives for: "No side-sewer backups in private residences due to inadequate SPU conveyance systems" (S.P.U. 2005). The storms which cause flooding in Madison Valley do not qualify under the parameters of this Comprehensive Drainage Plan level of service because they are very short duration storms (10-30 minutes) as compared to the more common intermediate duration storms (24 hours), which generally do not cause flooding. However, SPU's current project seeks to deliver an improved drainage service in Madison Valley that meets the Comprehensive Plan level of service (S.P.U. 2005).

Any project that would send stormwater into a waterway must get permits that meet the requirements of the *Endangered Species Act*. When stormwater is pumped into Lake Washington it can have negative affects on the water's ecosystems. Today, if stormwater was to be piped into Lake Washington, as was the plan in the 1970s, the regulatory process would be more rigorous. SPU is required to consult and get permit approval from the Washington Department of Ecology, US Fish and Wildlife, NOAA Fisheries, US Army Corp of Engineers, and the Native American Tribal governments in order to release stormwater into Lake Washington. The State Environmental Protection Act (SEPA) requirements would have to be met. In addition, the National Environmental Protection Act (NEPA) process would likely need to be followed due to salmon's status on the federal endangered species list (ESC 2007). Today, stormwater has to be treated before entering Lake Washington. Constructing a treatment facility that meets

today's standards on land directly east of Madison Valley would be more expensive than the construction of the piping system itself (ESC 2007).

The *Growth Management Act (GMA)* is a policy that affects development in Washington State. The GMA mandates that counties, and the localities within them, adopt comprehensive plans to regulate growth by creating denser urban areas that limit suburban and rural sprawl (Martin 2002). Portion of the hillsides west of Madison Valley have consequently been re-zoned for multi-unit housing. As a protective measure, the GMA also demands that infrastructure keep up with development: "public facilities and services necessary to support development shall be adequate to serve the development at the time the development is available for occupancy and use without decreasing current service levels below established minimum standards" (RCW 36.70A070). Generally this code applies to traffic infrastructure, but logically it would also apply to utility infrastructure in and around new construction. The GMA also encourages policies that require developers to pay impact fees that will help pay for public facilities and services required to meet the needs of new developments. These fees are passed on to the buyer in the price of the dwelling (Martin 2002).

Seattle Public Utilities decides what utility infrastructure is necessary on newly developed properties to capture storm and sewer water (Regan 2007). Thus, their policies affect how much more storm and sewer water from new construction is routed to 30th and East John.

Seattle Department of Planning and Development sets limits on the percentage of a property that can be impervious (or not able to absorb water). In the Madison Valley drainage basin, these percentages have an influence on the

quantity and quality of stormwater runoff that flows to the low-lying sections of the valley.[2]

CHAPTER 4 METHODS

Research paradigm

Based on the research goal of obtaining the knowledge held by local residents that could inform SPU's current utility project, I employed methods from the fields of community based action research and qualitative interviewing. Community based action research (CBAR) employs a collaborative approach to inquiry that endeavors to give people the means to take action to resolve specific problems. CBAR favors participatory procedures that enable people to investigate systematically their problems and issues, in order to formulate accounts of situations and to devise plans to deal with the problems. It makes use of techniques and strategies commonly used in behavioral and social sciences, and uses terminology that is accessible to both professional practitioners and laypersons. It is designed to encourage an approach to research that potentially has practical or theoretical outcomes and provides conditions for continuing action through the formation of a sense of community (Stringer 1999).

Action research has much in common with other traditions including practitioner research, action inquiry, action science, and community development. CBAR works on the assumption that all stakeholders whose lives are affected by the problem under study should be engaged in the process of investigation. By sharing their diverse knowledge and experiences, experts - professional and

[2] I contacted a public disclosure officer and employees at DPD to find out the impervious surface limits in the Madison Valley region, but did not receive a response.

laymen - can create solutions to their problems and, in the process, improve their quality of life. As stakeholders collectively investigate their own situation, they build a cohesive vision of the reality of the issue under study (Stringer 1999).

CBAR seeks to change the dynamics of research so that it is non-competitive, non-exploitative and enhances the lives of all those who participate. Cooperation and consensus making should be the primary orientation of the research activity. It seeks to link groups that are potentially in conflict to attain viable, sustainable, and effective solutions to their common problems through dialogue and negotiation. By including people in decisions about programs and services that serve them, practitioners extend their knowledge base and considerably mobilize the resources of the community. This can create the potential to alleviate many interconnected problems (Stringer, 1999).

The CBAR process presented here is derived from the interpretive research processes suggested by Denzin and Lincoln (2000) and Rubin and Rubin (2005). It is based on the assumption that knowledge inherent in people's everyday, taken-for-granted lives is as valid and useful as knowledge linked to concepts and theories of the academic disciplines or bureaucratic policies and procedures. The intent is to concede the limitations of expert knowledge and to acknowledge the competence, experience, understanding, and wisdom of ordinary people. It seeks to "give voice" to people who have previously been silent research subjects.

CBAR coupled with qualitative interviewing is an optimal method for this research project because there is a large body of anecdotal knowledge held in the Madison Valley neighborhood that is not readily available to the engineers

working on the long-term solution. The City's records on prior flooding in homes and yards is not readily accessible prior to the late 1990's (DeBoldt 2007; Regan 2007). Since this problem dates back to at least the early 1970s, it would be valuable to compile data from residents on frequency and levels of flooding over the years (DeBoldt 2007). In addition, since the current project only began in 2004, data on flow and depth of water in the area is limited (ESC 2007). Since the residents have an understanding and recollection of how the flooding phenomena have changed over time, this research attempts to supplement the monitored data with experiential observations.

The residents have an awareness of: 1) How often their homes and yards have flooded since they have lived in Madison Valley, 2) Where the excess water that gets into their homes and yards is coming from, 3) Whether this problem has gotten worse, 4) If so, why they think it is getting worse, and 5) What a successful long-term solution requires.

Research process

1. Position of the researcher

I have been a resident of Madison Valley since 2004 and have experienced a small amount of flooding from combined sewer backups in the basement during the 2004 and 2006 storms and surface water flooding in the yard in 2006.

2. Traits of key participants

In order to begin research it was necessary to identify the key participants. When conducting qualitative research by interview, it is important to find participants who are experienced and knowledgeable of the flooding problem. *Experience* in this research comes from having relevant, first-hand experience

with flooding. *Knowledgeable* participants were those who have lived in Madison Valley for over twenty years and residents who have been active in the community. Only talking to residents whom I already knew would not have provided a balanced and accurate picture (Rubin and Rubin 2005). However, the first few participants selected were the neighbors with whom I was acquainted, who had flooded on multiple occasions and expressed detailed observations and understanding of the problem.

Next I contacted representatives of the Greater Madison Valley Community Council and the local newsletter, the Valley View, to inform them of the project. As a result of this contact, a box of archived neighborhood documents with a section on "Flooding" was provided for the research. Reviewing the archived neighborhood documents provided a better understanding of who had lived in the neighborhood for a long time and who had taken time to be actively involved in the community. From this review of documents, a list was constructed with names of people who qualified as key residents for a first round of interviews. The yearly Madison Valley spaghetti dinner and pancake breakfast events took place soon after this review and I was able to meet some of the key residents at these social events and schedule interviews. During the first few interviews other people were suggested as potential participants due to their proximity to the flood zone, their membership in the Engineering Sub-Committee, and/or their length of residency in Madison Valley.

Presenting the research project at the Greater Madison Valley Community Council meeting on February 21, 2006 provided more volunteers and referrals for interview participation. Additionally, joining the Madison Valley Engineering

Sub-Committee meeting on February 22, 2006, provided an opportunity to meet residents who have been actively involved in representing the community through their membership on this committee. These residents had already done substantial work with the City's engineers, studying the interim and long-term solutions.

3. Interview Preparation

To prepare for this research project and the interviews with residents, I met with Linda DeBoldt, SPU's Project Specifier for the Madison Valley project, to learn more about the interim project and long-term solution plans. I also met with John Frech, the independent engineer/community liaison, to get a better understanding of how the interim solution works. In addition, I worked with Guillemette Regan, Seattle Public Utilities Public Disclosure Officer, to try to understand what effects combined sewer overflows in Madison Valley have on Lake Washington and to inquire about when the bond measure failed. These meetings were all very helpful.

4. Interview Participants

Residents have a vested interest in a long-term solution. Their response to this research project has been positive and many people were willing to spend valuable time, sharing their understanding of the problem and what they believed would constitute a solution. Ultimately, fifteen residents were interviewed for this project. The length of time these participants had lived in Madison Valley ranged from three to fifty-five years. The interviews generally took place in participants' homes, and were recorded. Some of the participants have more at stake than others as they have received more frequent and intense flooding over the years. However, since the goal of the research is to find out what residents

know about the area they live in, all viewpoints are equally relevant. All interviewees were informed that their names and addresses would be kept confidential. Due to the fact that some residents have asked SPU to compensate them for a loss of property value and have expressed that they may sue for this loss of property value, I did not want interview participants to feel intimidated about talking openly about their flooding experiences for fear that it would have any negative effects on their specific home's value.

Capture

This study used interviewing, data collection, and data analysis procedures suggested by Stringer (1999), Lincoln and Guba (1989), Denzin (2000), and Rubin and Rubin (2005). The questions that were asked of the interviewees included:

1. How long the resident had lived in Madison Valley.
2. How many times their properties had flooded and to what level.
3. How the water reached their property.
4. How their property had been modified to deal with the excess water.
5. What they thought were the biggest contributors to flooding.
6. Which of SPU's alternatives they preferred.
7. What other ideas they had for a long-term solution.
8. Whether they would like to see SPU involve the community.
9. What they would like to know more about for their own analysis.
10. Whether they thought there was anything the residents of Madison Valley should do to advance their preferred long-term solution.

The interviews were recorded with a Sony Walkman and generally lasted one hour or more. They were conducted from February 19, 2007 to April 5, 2007. A couple of the participants drew the water's overland flow on a map of the Madison Valley basin. One participant took me on a walk to show how the water moved through the streets and backyards.

Other data collection included compiling news articles on the flooding in Madison Valley from the Seattle Post-Intelligencer and the Seattle Times. Copies of the Seattle Star, the Madison Park Times, and the Valley View newsletter that contained flooding articles were provided by residents. The Greater Madison Community Council provided documentation of flooding from the 1990's and early 2000's. Community Council files prior to the 1990s are no longer available as they had reportedly been stored at the now closed Martin Luther King, Jr. elementary school and were destroyed by an administrator.

After interviews I spent time walking around the neighborhood to find the wet areas mentioned in interviews. Sometimes I took a camera to photograph the scenes as a way to make the narrative descriptions more meaningful. Lastly, I have attended all of the Engineering Sub-Committee meetings since February to stay apprised of SPU's progress on the engineering analysis of the project and to learn more from the community representatives about the ideas and priorities expressed by community members.

Interpretive procedures

Established procedures enable researchers to reduce, condense, or distill information, so that significant features of people's experience become available in a readily accessible form. This section describes details of procedures used for

this reduction process. In general, these forms of analysis establish categories and key elements of experience that provide the framework and content of accounts that form the results section of this research. Denzin and Lincoln (2000), Guba and Lincoln (1989), and Rubin and Rubin (2005) informed the way I went about constructing the evaluation of information that follows.

In order to expand the current state of knowledge held by SPU with an additional construction of knowledge based on the local knowledge in the neighborhood, I developed a list of the major themes that came up in the interviews and created codes or abbreviations for each theme. Then as I read through the transcribed interviews the codes were added where appropriate. I was then able to pull together all the different responses related to one category. After I had categorized the responses, I organized the categories around broader topic areas (i.e. definition of the problem, major contributors to the problem, ideas for solutions to the problem, desire for community involvement, and environmental justice concerns). When possible I endeavor to use the actual language from the interviews to share the knowledge. The thick descriptions from the interviews provide vicarious experience, which may challenge the current constructions of the flooding problem and lead to new, more broadly informed constructions of the problem and solution to flooding in Madison Valley (Geertz 1973; Guba and Lincoln 1989). There are many ways to organize information and to put together an interpretive constructivist evaluation. The order used here is what appeared most logical to me.

Rigor

1. Credibility

Credibility of the participants was originally established through my own prior relationship with them, through their community involvement, and/or by referral from other trusted residents. I spent an hour or more with the participants in each interview. When recurring themes were voiced I listened carefully to see if people were corroborating observations.

2. Transferability

In reading the narratives provided, readers in other neighborhoods throughout the country who are experiencing problems due to out-of-date stormwater systems may find similarities. The narratives may also be recognized by other neighborhoods in the Puget Sound that are experiencing flooding and would like to see a broader knowledge base involved in the construction of the problem and solutions. The research will hopefully demonstrate that local ecological knowledge can provide valuable insights in urban areas that are situated in built and modified natural environments.

3. Dependability and confirmability

Though my situation as a resident in this neighborhood is unique, I believe that if this method was employed by others, similar results would be obtained.

4. Limitations

A limitation of this research endeavor was that home ownership in Madison Valley has changed dramatically since the 1970s when the combined sewer backup problem is believed to have started. Valuable residents who hold key historical knowledge no longer live in the neighborhood or have passed away.

Additionally, there are many existing residents who would be valuable research participants for this project, but due to time constraints, I was only able to interview fifteen residents to construct this body of research. Lastly, though the research methods used in this project were inspired by Community Based Action Research, I was unable to fulfill the "action" element of this method, meaning I have not gone back over the results with the interview participants to define a combined vision of the problem and possible solutions. I believe in the value of creating cohesive goals and plans within the community and with SPU and hope that as I continue to be involved as a community resident and not a student, there will be more time to work on creating goals for this project that are collaborative.

Ethical issues

Ethical issues were addressed in the Human Subjects Review Application process at The Evergreen State College. I decided that it would be best to keep participants identities and addresses confidential, so that they would feel safe in sharing what they knew. Participants were also informed ahead of time that the interviews might cause anguish to those who have experienced great losses from the flooding of their property and/or their neighbors' properties. All participants were informed that they were welcome to a copy of the thesis when it is complete.

CHAPTER 5 RESULTS AND DISCUSSION

In this section, results from the interviews, community documents, and Engineering Sub-Committee meetings are synthesized and broken down by subject. Narratives are included as much as possible, since the goal of the research is to establish the residents' knowledge of the problem. At the end of each subject area, possible points of future discussion are suggested.

The first thing I inquired of interview participants was whether their home, yard, or basement had flooded and how and when that had happened. Everyone had experienced water in their basements and yards, except for one local participant, who had friends and family members who had since the 1960's.

How the flooding occurs

There are a variety of ways that the water enters people's basements in this area. Some get it seeping through the cracks in their basement during or after rains because of saturated groundwater. One person noted, "As the water plate would rise, the water would literally bubble up through my basement foundation." Many houses have sump pumps and drainpipe systems to convey the groundwater seepage to the utility system, their yard, or the street before it reaches their basement floor. In the heaviest rains, "if there's enough stormwater in the system, the sump pumps will fail and some people… have water coming back out into their [basement] drains, especially if they don't have a check valve." The third way is when water "comes over the sides of people's foundations or down through stairwells and rushes into the basements." This water consists of surface runoff and/or combined sewer backup from pipes in the streets. A long-time resident described how during the heaviest storms the water would "pop those caps off the middle of the street and water would spew up like a fountain five or six feet up in the air. It is just a big fountain of water spewing up."

Some properties retain water in the backyard during the winter. One resident dug a hole in her backyard for water retention and in the winter "this area fills up with water like a pond." Her neighbor has a sump pump in his yard that goes out to the street to help with drainage. On the blocks that had very low-lying

yards, many residents have filled them in with dirt or compost to help keep things dry. One resident explained that, "A lot of the people on this block for many years have been putting fill in their backyard… If you looked at the height of the backyards over time it looks like a checkerboard. People are just trying to build above. I guess the clay is what causes us to have standing water."

Another resident who used to have standing water in her backyard in the wintertime changed the landscaping.

> There was just grass back there. What we did is we removed the fences, plowed up the grass and re-landscaped and created in essence a huge drainage. We're putting in rock, using it to create paths and a patio area and the base of that is gravel and sand. Most of our drainage problems went away because of that.

The variety of methods that residents have used to deal with water on their property is one example of the local ecological knowledge (LEK) that exists in this area. Situations on any given property are unique and inspire a multitude of techniques for keeping basements and garages as dry as possible. This experience on personal property contributes to a keen observance of water throughout the drainage basin. Many of the participants were additionally able to describe the areas in the neighborhood where they had seen the most standing water.

The majority of the residents I spoke with had flooded at least twice recently: on August 22, 2004 and on December 14, 2006. A few had flooding in their basements and yards dating back to the 1970's. The majority of the participants in this research did not have finished basements. Thus, their losses were not as great. However, one resident who has lived in Madison Valley for twenty years and had not flooded prior to December 14, 2006 lost "family heirloom photos from the 1900s and her great grandfather's desk that he sat in at

the bank." Those who do have finished basements lost much more and have made claims to have their basements repaired. However, many of the antique items may not be compensated for under the insurance guidelines. Some participants expressed strong opinions that there "should not be finished basements in the lowest points."

This is a contentious issue since many of the residents in Madison Valley rely on their basements as living space and suffer when it is not usable. However, until the long-term solution is implemented there is still danger that finished basements will be damaged again. In the Engineering Sub-Committee meetings, we are discussing emergency plans that include methods to: 1) drain backyards during medium storms, 2) alert people when the detention pond is beginning to fill up, and 3) sandbag homes and garages. The community representatives have suggested ideas for these emergency practices based on their knowledge of the area that SPU engineers have found helpful.

Understanding of what contributes to the problem

1. Natural features

A second question posed in the interviews asked what the participants thought was the main contributor to flooding in this area. A common factor identified was the steepness of the hills surrounding the valley.

> The essential part is that we're at the bottom of the valley. Naturally water's going to run downhill. You've got Capitol Hill around us and Madison Park.

SPU has also spoken to this point, pointing out that the average grade of surfaces in the drainage basin is 10% (ESC 2007). Poor draining clay soil was also acknowledged as a contributor. Many participants took their observations of

the natural features of the area that encourage flooding a step further and noted the prior history of the streambed here and their concern that the blocking of its route at Madison Street is a major problem during storms:

> This is an old streambed. A stream used to run down here and along Madison, so from what I know of what SPU has done historically there's not a lot of way for water to get out of the valley once it comes down. So when we get a lot of runoff coming down from all the hills, it runs in the valley and has nowhere to go.

Another participant shared that:

> There were photos of the area before these roads were elevated or built up a little bit that show that there was an intermit stream at the bottom of the valley every year, every rainy season basically. So these streets, because they're built above the level of the valley… the natural drainage of the area was totally closed off. Usually out in rural areas there are culverts under them. So these are dams with no culverts under them. It's been really interesting to us why that wasn't part of the temporary solution, to open up the natural drainage. I think we're especially sensitized to this now after Hurricane Katrina. Because I'm a geographer and taught physical and environmental geography, I've always been interested in these kinds of issues about natural drainage. But it was really frustrating that instead of doing something that is more natural… like for instance… daylighting the stream in the Ravenna Creek project, why nothing like that was discussed here at all. Like it's always been an infrastructure thing. They're always going to build bigger and bigger pipes, bigger and bigger holding things and why haven't there been different considerations like that? The City created these dams and so basically we're behind a dam every summer… the 200 and 300 blocks especially… We just imagine that somehow or another anything that approaches the Arboretum is sacrosanct. So they're not going to do anything to help this neighborhood if it does anything that the Arboretum doesn't want, because it's our precious jewel. Like anywhere else, it [the water] might do some damage but it's insignificant. [A]long the streambed, there are streambed plants; it [the Arboretum streambed] doesn't seem like it's that fragile in that sense. For millennia, every so often, a bunch of water went through it. I think you definitely want to protect it. You want to make sure there's nothing unnatural happening to it, but I don't see why there would be.

The residents of Madison Valley are definitely concerned about the man-made dam under E. Madison Street and solution ideas for this problem will be presented in following sections. The sentiment that the Washington Park Arboretum or the soccer field present barriers to protecting the homes in Madison Valley is something that many participants were concerned about. They would really like to see the City departments work together on this to find a solution that makes sense for the neighborhood and the Washington Park Arboretum.

2. Environmental Injustice

As noted above in the history section, Madison Valley was an African American and lower income neighborhood for most of its existence as a developed area. SPU's research into this problem for the current project has established that there have been ten storms that have caused combined sewer backups in the vicinity of 30th and East John since the separation of stormwater pipes was implemented in the early 1970s (S.P.U. 2006). Though the August 2004 and December 2006 storms were the most intense in recorded history, there is a sentiment among some residents that the reason the City is finally working on a project is because in 2004 the racial and economic make-up of the neighborhood had changed and that this was evident at the community hearing after this flood. One participant described the social history of the neighborhood:

> It was the first working class black neighborhood in Seattle. And there are a lot of people, our Black neighbors, who are living in the houses they were born in. These are like multiple generation households where the house was built by a grandparent of somebody that's still living in that house, all over the neighborhood.

Another participant pragmatically stated:

> The old saying is that the majority of the people when it was first happening in that area were African American and you know race does play an issue. They weren't going to get any attention until there was a significant number of European Americans in the community. Then it becomes an issue.

A resident who grew up just a couple miles away was appalled that she had never heard of the flooding problem even after doing thorough research when buying her home.

> Historically that had been a poor neighborhood and so the City never had a fight from anybody. But when things happened in my parent's neighborhood on Capitol Hill, they were fixed immediately and this never would have been a recurring thing you know… over a 30-year period. This never would've happened.

One participant also suggested that economic standing as well as race was an issue.

> This was traditionally a Black neighborhood… So if you have a flooding problem, whose going to worry about it? You're poor people - that's what comes with the land. You have flooding problems. I mean the same thing is happening now in East King County and East Snohomish County where poor people live and many of them have huge flooding problems. They had huge flooding problems this past winter…out on Highway 2. Their land floods - you have no relief. If you look at whose wading through the mud it isn't people of wealth. But I think the problems are just becoming greater and greater.

When reviewing the community documentation on flooding it was easy to understand why people would feel this way. After the flood in 1996 that caused damage to approximately 27 homes, a response letter from a law office to the Madison Valley Community Council states:

> For the past 10 years, commercial development along Madison Avenue and adjacent communities increased the drainage/sewer capacity in the Madison Valley area. Twelve inch pipes now drain

> into the Valley's six inch pipes, causing severe property damage. Title insurance companies are claiming that the area is not within a designated floodzone. Owners are unable to claim an insurable loss.
>
> The City or King County are in the process of reviewing engineering studies. Both municipalities are claiming no responsibility to the problem (Tate 1996).

An additional letter sent by the Miller Park Neighborhood Association to Seattle City Council member Jane Noland the following year wrote on behalf of a group of Madison Valley residents described as "mostly "older" and mostly African American" who attended a monthly Madison-Miller Urban Village planning meeting to express their concern about the chronic sewage backup problem in their basements. This letter notes:

> As it seems such a disgusting and chronic problem, I wanted to make sure you [are] aware of it, and ask your advice on how to resolve it. I was also concerned that, as they claim it is a 20 year problem, it may be an example of the Central Area being ignored by the City (Taylor 1997).

The author of this letter did receive multiple responses from the City that they were working on the problem and that a 380,000 detention tank had been put built under 30th Avenue E. to help with storage capacity in the early 1980s (Buntine 1997).

These narratives serve to establish that social and economic factors more than likely contributed to this problem not being resolved earlier. Local governments are pulled in countless directions for addressing problems and until 2004 they had "gotten away with" just paying small claims over the years when big storms caused sewage backups. Now that the City of Seattle is working on a solution, it is important that the community members continue to be involved in

the planning process to help ensure that future utility infrastructure and development in this area be planned in a way that is sustainable and does not represent "another band-aid" fix. Though I have not done a statistical analysis of the distribution of flooding problems across demographic groups in Seattle, intuitively it seems fair to say that this was a clear case of environmental injustice. At this point in time, I find it appropriate to keep social equity in mind when considering other challenges and contributors to the problem.

3. Surface Water Runoff

Another contributor to the problem suggested by the interview participants was inspired by the most recent flood. The December 14th storm brought the issue of surface water runoff to the forefront of many people's minds due to the situation on their own properties. Many participants responded that they witnessed the water moving down the hills and that it was largely unable to get into the storm drains because they were too small, not in ideal locations, clogged, and/or the pipes themselves were already full. Since the most recent storm took place toward the end of the standard workday, many residents were already home or traveling home during the storm and were able to witness it.

One resident who bicycled home during the December 14, 2006 storm witnessed the surface water's movement down the hills on and stated:

> The biggest problem is runoff, which the City hasn't addressed. Why are the sewers becoming overwhelmed with volumes of water? It's not just rain. It's because we're getting rain from Madrona, Capitol Hill, Denny-Blaine, and Lake Washington [neighborhoods]. I think we could've handled the storm we had this last time... I only got water because the sewers reached capacity. And that's happening because all the water is running through this area and no one addresses that. If the city got four

inches, Madison Valley got double that because we're taking it all on.

This resident did some follow up work and submitted photographic documentation of what he sees as an inadequate stormwater collection system (Figure 3).

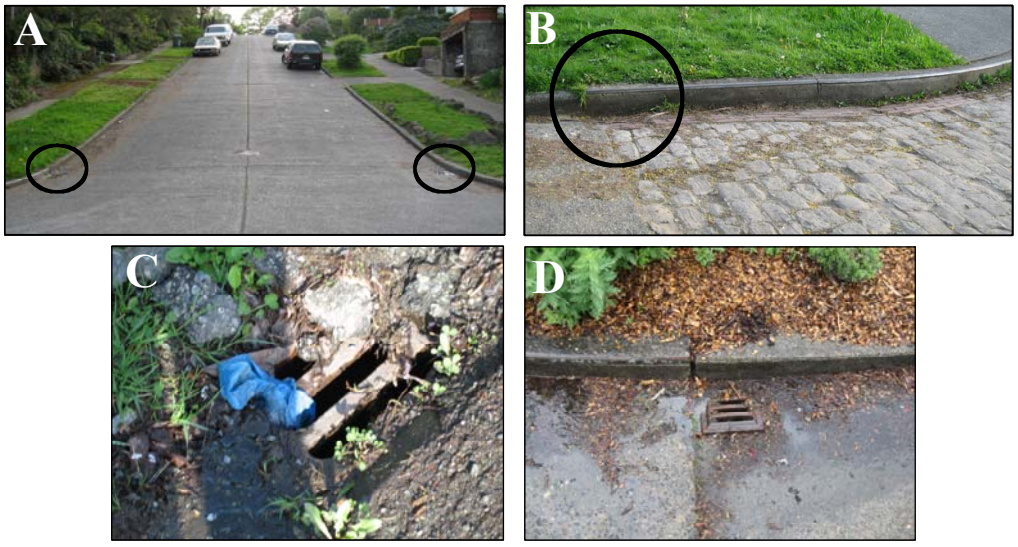

Figure 3. Storm drains in Madison Valley. **(A)** General position of storm drains. **(B & C)** Representation of clogged storm drains. **(D)** An out-of-date smaller drain. Circles represent location of storm drains.

Some of the participants noted that their basements flooded for the first time on December 14, 2006 and that the amount of water that entered basements from the outside was greater than the amount that came up out of the utility pipes. One resident noted the relationship between the surface water problem and the long-term solution alternatives:

> The rate at which surface water comes down here is a serious problem for the drains here… Even after the flood here [on 12/14/06], we saw a very heavy rainstorm right in front of the [Essential] Bakery. We saw water coming out of the storm drain. It wasn't even raining that hard, but the water was coming out of the storm drain because the sewer system there was completely full and water was gushing out and down onto the street. The problem with these detention plans is if they still involve saving the

> stormwater here… in these big tanks… You can still wind up with surface flooding, which is how we get a lot of our rain. It's not going into drains. The drains are clogged or it just bypasses the drains and it suddenly just winds up being everywhere.

On the same subject, a few people brought up the issue of the storm drains not being cleaned often enough.

> Something that is clearly a factor adding to the flooding is the lack of the City in clearing the falling autumn leaves from the storm sewers. The storm sewers on Madison from MLK to the Arboretum Soccer Field were overloaded with leaves, so water backed up. The water pouring down Madison Hill, west of MLK had no place to go. Some of the neighbors around 2820 East Madison went out and cleared the leaves a few times, to let the water drain into the storm sewers, but more leaves came and clogged the storm sewers. During the autumn falling leave season, in flood prone areas, the city service staff should proactively come around and sweep up/vacuum up the curbs and storm sewers on a regular basis, to prevent future backups of water. When there was a flood in the summer, two years ago, there were no leaves around clogging the storm sewers, and the street didn't flood like the most recent flooding incident.

The observations that the residents have made regarding the surface water runoff issue provide another example of LEK of the problem. They were able to witness the December 14, 2006 storm event and compare it to past events. The engineers have water flow and volume monitors placed throughout the area, which is necessary for their engineering models. As a complement to this, many residents could provide experiential knowledge of where the most flood prone street surface areas are from their observations walking around the neighborhood and from living through the last storm and other less intense rains. Another factor in the surface runoff problem is the size of the pipes. Something that the residents could use a better understanding of is how big the pipes in Madison Valley are and whether this is a major part of the problem. I recently learned that the pipes

under E. Madison Street are twelve inches in diameter (CH2MHill 2007). This does not sound big enough for such a major thoroughfare that is so steep and densely built up. This leads to the next major contribution to flooding voiced by residents.

4. Development and loss of permeable surfaces

A contribution to the flooding problem that was voiced repeatedly in interviews was the observation of rapid construction of dense housing units on the hillsides to the west of the lower-lying streets in Madison Valley and the corresponding loss of permeable surface or absorption. Almost all participants referred to housing development as a factor in the increased range of the flooding. The following three passages were the most detailed explanations of the understanding of this problem.

> I think the second big contributor is all the development on East Capitol Hill from here marching down to Jackson. But there has been significant development on this one swath of land that I would say is bounded by East Union and East Madison Streets and goes up to 18th or 17th (to the top of the hill), where… what were homes with trees with some yard, becomes: the houses removed, the trees are removed, and these four pillars that are called townhomes are constructed and they sit on a concrete pad… they sit in this little bowl so all the runoff goes into the central basin and into the City's storm system which runs down the hill and gets held down there, but there's no natural absorption. It's like the City is permitting developers to eliminate the natural absorption process or the natural slowing down of runoff. They're totally behind development infrastructure, they just are. Developers can work faster than the City can, because they're just doing these little units and the City has to take this long view and plan and find millions and millions and millions of dollars to create drainage infrastructure. And, they haven't done it here.

Another participant looked at it in a mathematical way:

> There's a point at which the ground can handle you putting a building there, right? The surrounding vegetation can handle the

> rainwater and you don't wind up ultimately flooding. And then there's the point at which your ground is 50% paved and 20% covered with houses, or 70% impervious surface. You're relying on the 30% left to absorb rainwater, plus the gutters. If you change that from each lot being 20% covered by a house to 40% covered by a house, now instead of having 30% of the land absorbing rainwater, you've only got 10%, so you've cut 2/3 of your rain holding vegetation by allowing that intense development.

This resident agrees and thinks that the developers need to be held to higher standards and that environmental impacts need to be assessed cumulatively:

> With all the development, my issue is that the developers are just developing over problems instead of fixing them. We had two houses that were built in our neighborhood and they kept getting that daylighting of the stream that comes down Helen [Street]. For years we grew up with that thing so that when it was winter or when it snowed it would just be a sheet of ice. It was a given, always. There was always that dripping water. So they re-directed it back in the sewers. But they'd think that they'd got it and it would just pop up somewhere else. It was a demon spring to developers. Some developers would only do patch work, enough to get the building done and then leave the problem to the owner once they're gone. We don't know how they did it and whether it's a long lasting remedy.

> The issue that I have is that with all the development and stuff that's going on, when the developers do their analysis and impact studies, even with the runoff and traffic and everything else, you need to start looking at it from a cumulative perspective. I think that may be some of the problem. They're going, "Well, we do an impact statement." But, it's just for that one [property] alone. They're contributing to a bigger picture. And that bigger picture is affecting other people. And there's so much development going on and… it's a cumulative effect. It's a nightmare.

It is important to note that most of the participants expressed that they were not opposed to density, but that they did not think the loss of unpaved land was being adequately mitigated for in new construction or remodel construction. In addition, the added wastewater when a single-family dwelling is increased to four and six unit townhomes appears dangerous when there is already a clear

understanding that the utility system is under-capacity during storms. Many people added that the intense development of the area coupled with climate change is what is causing the problem to get worse. Though, the residents think that it is obvious that unmitigated dense development is a large contributor to the problem, this is not something that SPU's project team talks about. It is hard to know how apprised of the growth they are. There appears to be an urgent need for coordination between Seattle Public Utilities, the Department of Planning and Development, and the community so that this project will be effective for the long-term.

5. Global warming effects on storms

More than half of the people I interviewed mentioned global warming as a factor that will exacerbate the problem. Though no one knows exactly what kind of effects warming will have on our area, the residents understand that there is an even greater frailty within the system than was previously unknown. Many would like a better understanding of how global warming will be accounted for in the planning process.

> I realize these are unusual events, but we've had enough of them now that they're not so unusual and I think that's the real concern - that the City's got to deal with the reality of what we face today and like I said it's not just what's happening when we have these events, but the prospect that these events can become more prevalent through global warming.

Another participant suggested revising the rainfall probability models:

> If you look at it, these things are getting progressively worse. Our water tables and our rain levels have risen significantly. We're talking about the greenhouse effect here, so we need to take that into consideration. So I would much rather have too much [storage capacity] than too little. That may be one thing they need to do…

> is do a study of the rainfall increase and do a probability study of going forward what would be a probable increase.

The concern over global warming effects on flooding is shared by Seattle Public Utilities (DeBoldt 2007; Regan 2007). I think that it is extremely relevant to the type of solution that is selected. The residents want to feel safe in their homes when it is raining hard, but some have also expressed a desire for a solution that works more naturally with the environment. Some of the residents also expressed the educational benefits of more natural solutions. The following section presents some of their ideas.

Ideas for a long-term solution

In addition to the residents' knowledge of the contributors to the problem, they had a lot to offer in terms of ideas for the long-term solution. In this section, the residents' opinions of the current long-term solution alternatives will be analyzed and then I will present some of the additional modifications they think are important.

1. Opinions of SPU's current long-term solutions

Since SPU had already developed three preferred long-term solutions, which are currently being modeled with the most recent storm data, I asked the participants if they had a preference in terms of these alternatives (See Figure 2). For some, there was a preference for Option C, which tunnels the stormwater directly east to Lake Washington. To these residents, Option C represents the most effective solution and as stated earlier it represents what was initially planned during the Forward Thrust stormwater separation project. A long time

resident let me know that part of his preference for this option was that he understands that it would work.

> I would be totally guessing about any of them, unless they take that big pipe and run it straight on out of here. The other ones I would be totally guessing because just as that water came in this time, if those pipes are not big enough to get it out of here, it's got to go somewhere and it comes back out into our yards. But, I do know that the bigger pipe would go right straight through here into the Lake… It's just that they [the storms] are getting bigger, so I want them to get it out of here.

Many of the participants in this research felt that the current regulations on draining stormwater into Lake Washington would make it too costly and time-consuming of a solution. Additionally, although SPU added this option back to the list after the December 14, 2006 storm, recent consultations with the regulatory agencies and an SPU-wide engineering forum held on the Madison Valley project have led the project team to the conclusion that this option is not cost effective and may not be the best at capturing the water. SPU shared that the cost of tunneling and treating the stormwater is estimated to be over $80 million, that there is a risk this alternative might never get approved by the permitting agencies, and that there are engineering challenges related to directing the majority of the water into the conveyance pipe (ESC 2007).

Overall, interview reactions to Option A were lackluster or negative. Some people questioned whether the water will actually get into the tank due to the poor storm drain catchment capacity exhibited on December 14, 2006. Others were concerned that it would retain the hazard of overflow flooding in this area. Part of the reason Option A is not popular is due to the fact that the new detention pond filled so quickly on December 14th, 2006. One person observed:

> Having seen the detention pond… going up and overflowing makes me nervous about creating another detention pond; because where's the first place it's going to go? We're essentially the overflow and I'd hate to see that happen again… The idea is that we want to increase the output.

Another resident expressed concern for the morale and livability of the neighborhood.

> On a worst case basis, the City may decide given budget constraints, we'll just build a huge pond or buy out a whole block or two, build these underground tanks, rather than pump it out into Lake Washington or pump it out into someplace else. Yeah, maybe they have to buy out more of the neighborhood to do it, but that will end up being a cheaper and maybe quicker solution and, it might be one that people buy into just because it's cheaper and quicker. But what will that do to the greater neighborhood to know that they've condemned and made one center of the neighborhood basically an industrial processing plant for the storm system?

Many participants believe that Option A is preferable to SPU because it's easier to get done:

> I think they know they could get the big tank done fastest. But that still doesn't take the large volume of water out of the valley. I think they heard that we want to fix this as soon as possible, but hopefully from the last meeting they took away that we want a good solution and we're willing to wait.

In terms of effectiveness, Option A may be viable, but in terms of overall quality of life in the neighborhood, I got the impression that people would prefer to see some changes in the overall infrastructure that would not require so much of the sewer and waste water in the drainage basin to be routed to 30th and East John. These ideas will be discussed further below.

The majority of the participants who I met with preferred Option B, because it represents a solution that gets the water out of Madison Valley, but won't have as many permitting barriers as Option C. One participant expressed:

I like Option B, but in strategic locations, they need to construct bigger storm grates… Bigger grates linked into the piping of Option B and create little burms like they have on the east side in Medina.

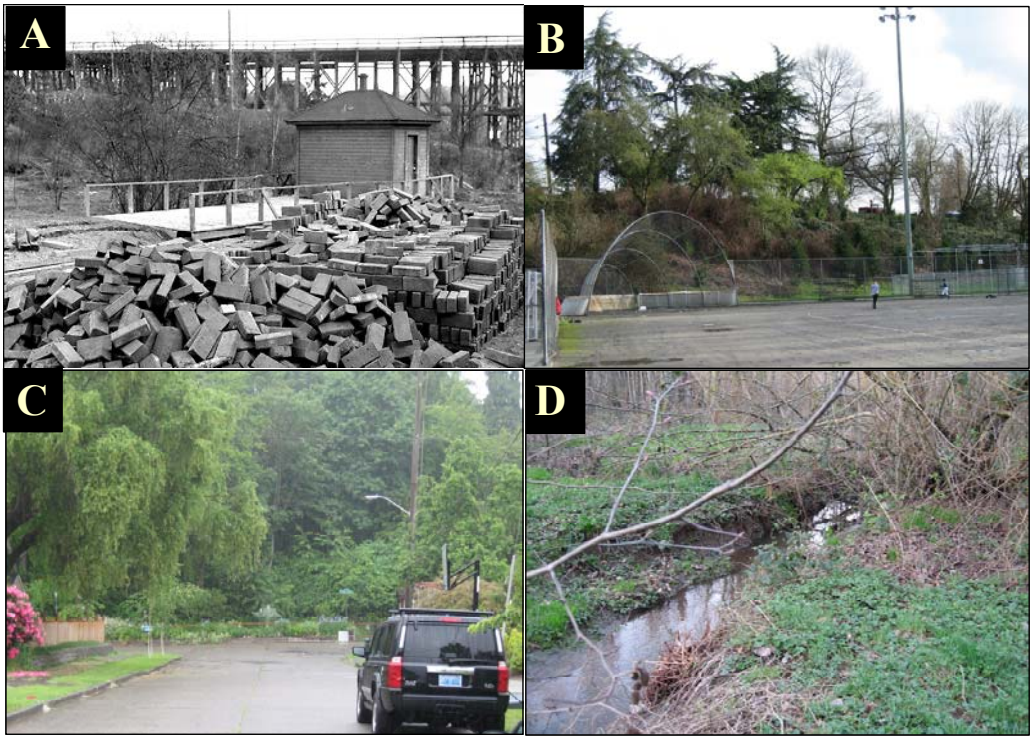

Figure 4. Photos of prior drainage route. **(A)** The Madison Street Trestle as it appeared from Washington Park in 1912. Adapted from Seattle Municipal Archives. **(B)** View of E. Madison Street from a similar location in Washington Park in 2007. **(C)** View from the opposite side on 30th Ave E - looking north at the filled in area under E Madison Street. **(D)** The creek in the Washington Park Arboretum which runs north to Lake Washington. Photos B, C, and D taken in 2007 by author.

2. Natural drainage features

Many participants, though not all, voiced a need for more natural drainage facilities in addition to Option B. This was an area where local knowledge is very apparent and residents were passionate in their desire to restore some of the natural water features to the area in an effort to provide a better buffer to flooding in the low-lying areas and to re-connect the neighborhood with the Arboretum (Figure 4). Residents have seen and read about restored streams and more natural

stormwater filtering methods in other parts of the City and do not understand why these options have not been discussed in Madison Valley.

> The solution I see is taking that pipe basically through the Arboretum down the traditional drainage. Like before the trestle bridge was filled in that created this dam… I would think that given all the things that are going to happen in the next twenty years it could be sensible to take the water out that way and do something similar to what you see with Ravenna Creek and other drainages in the Seattle area where you do a combination of above ground and below ground drainage and retention, sort of a restoration of original hydrology coupled with traditional detention and drainage methods and send it out to Lake Washington in that direction. Work with the Arboretum and the Parks Department restoring wetlands. You probably can imagine that it was a swamp or very swampy and you still have that creek running through. You could basically enhance and expand the wetland that starts at Lake Washington and just bring it up the Valley. And you could provide some overflow capacity, punch a hole through the dam to create a passage for water; create a passage for people and overflow in storm events so you don't have it pooling down there at the bottom.

Another resident suggested a way to alleviate the need for tanks as much as possible by filtering the stormwater more naturally on its historical route north to Lake Washington.

> I wouldn't detain the water there at the Arboretum. Why detain it, why not run it through a series of burbling wetlands and send it on down to Lake Washington? Because as it is right now all the overflow just gets dumped anyway through the pump system, so why not filter it through a series of wetlands? In the Arboretum there are places that could be temporary wet areas as it goes down. There are already a series of wetish areas. We only have these big storms once in a great while. Why not take all the surface water runoff and just let it drain to where the ball field is? They could even dig out the ball field and make it a little lower than it already is. It could still be a soccer field and it could be a huge flat area and since oils stick to organic matter as the water flooded out through there it would be filtered. Maybe they'd have to re-chalk or re-grade the field, but it's no big deal compared to having to re-do everyone's basements or build a gigantic tank. Better to open a stream there because there used to be a stream there anyway. Since Capitol Hill also has a problem and Madison Ave. does too,

> put the water on the side of the soccer field. There's also a huge grassy area on both sides of the soccer field. Either one could be lowered to just hold water for when it floods. What bothers me about that is that you have to accommodate every single thing that you're doing. You can have a playfield anywhere, so have it all open.

One participant felt very strongly about the need for restoration of the prior stream:

> I really feel the only way to keep people safe is to buy out a portion of that area and put back in a natural river that has a hole and goes back under Madison and if it needs to flood out somewhere, it'll flood onto the playfield… [T]he water needs to go, it needs to get out. And the only sensible thing to do is to create that natural exit for it again… [I]t would have to displace a lot of people and I just hate even saying that, but I just don't want to see another person die. Because we knew it was going to happen and it did. And whether they prove that it has something to do with this issue or not, it's all related. It's just a disaster. I really don't see a win in this situation. I think the only way that it's going to be able to be fixed completely is again either to eliminate basements in that neighborhood and replace basements with a second story or buy out a whole line of houses all the way down to Madison and create a natural river again or natural creek.

In reading old issues of the Valley View, it is clear that this desire for a water and pedestrian passage under Madison Ave at 30th and E. Mercer has existed for a long time. It would be extremely valuable for the residents in this area to know that when water runs down the hills in heavy storms that it has somewhere to go. The added ability to walk directly to the Arboretum would also be invaluable for residents of all ages.

This idea has been looked into to some extent by the SPU team. They have already faced serious resistance from the Washington Park Arboretum and the U.S. Army Corps of Engineers to the idea of allowing stormwater to enter the creek in the Arboretum. Considering how much research is being done on

stormwater and wetlands, the idea of filtering overflow water through wetlands in this area could provide an educational research area close to University of Washington. The SPU team appears to be more confident that they may be able to work with the Parks Department on an overflow area below the soccer field (ESC 2007).

3. Additional suggestions for a long-term solution

a. Development Mitigation

Many residents are aware of low impact development (LID) strategies that help to mitigate stormwater runoff. Since dense and highly paved development is such a concern, a few participants provided suggestions for what can be done to protect the homes in Madison Valley from increased stormwater runoff. The first suggestion involves a program for cisterns. This participant noted that people could catch water in them in the winter, and by mid-July they would likely have used most of the water on their yards, so there would be room in them again for the summer storms.

> We don't need to catch 3 million gallons; we just need to catch some of it. If you catch 500,000 gallons in people's cisterns and another 500,000 gallons slowly inside the little shark-fin shaped storm swales all over the hillsides, you've increased the quality of life all over the place; you've reduced the cost of processing stormwater and people's water bills, because they're going to be watering their yards with it. And at the same time they can build a smaller project.

A cistern program already exists in the Wallingford/Fremont neighborhood, so this may be something that a group of residents could find funding for. In addition, we would need to educate the broader neighborhood on the environmental and neighborhood benefits of putting in cisterns. LID

techniques for slowing down stormwater and filtering it through swales are becoming more prevalent in cities and towns nationwide (Figure 5). These features help connect social and ecological systems by giving humans a better view of nature as it moves through a developed area.

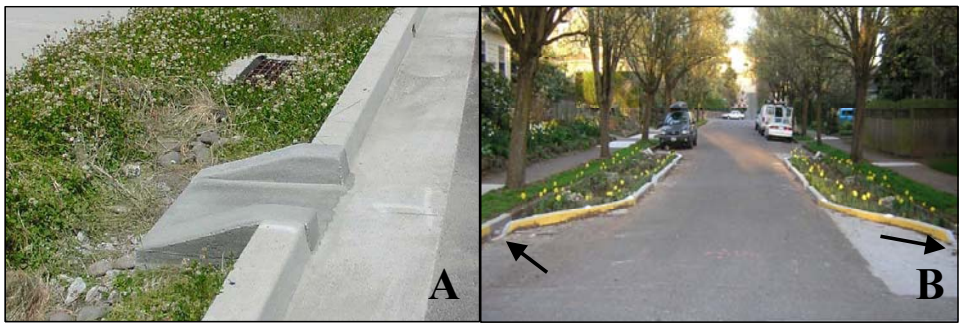

Figure 5. Low Impact Development (LID) strategies. **(A)** Street swale with overflow catch basin and curb spillway. **(B)** Vegetated street swales. Arrows point out the area where stormwater can enter the swale.

b. Re-distribution of stormwater pipes

After seeing SPU's map of the piping infrastructure, many participants felt that some of the utility pipes should be re-directed so that less of flow comes to 30th and East John (Figure 6).

> If they take the storm drains that come down Madison and divert them directly north, then that's a lot of water that's not going to enter this valley… If you think about it all the new buildings going in on Madison, the Safeway apartment buildings… that all puts water straight into the storm drain system. That's a lot of water that rapidly enters the storm drain system and to expect it to hook directly into these drains here, we're going to need more capacity and we're going to have a higher chance of surface flooding. If they put it to the north of Madison, it's not attached to the pipes that come south of Madison… It's this juncture at 24th and Madison. That's a mistake. It doesn't have to be that way. If they did that and the same thing with the water coming down 32nd that could be a lot of water that no longer enters this valley.

At the ESC meetings on May 10, 2007 and May 31, 2007, SPU reported that they are going to analyze the possibility of re-distributing the water that

comes from the Northwest lobe of the piping system in their engineering model to find out if this presents a viable element of the long-term solution. This response from SPU helps to validate the concept that the knowledge and ideas held by residents can be helpful to the project.

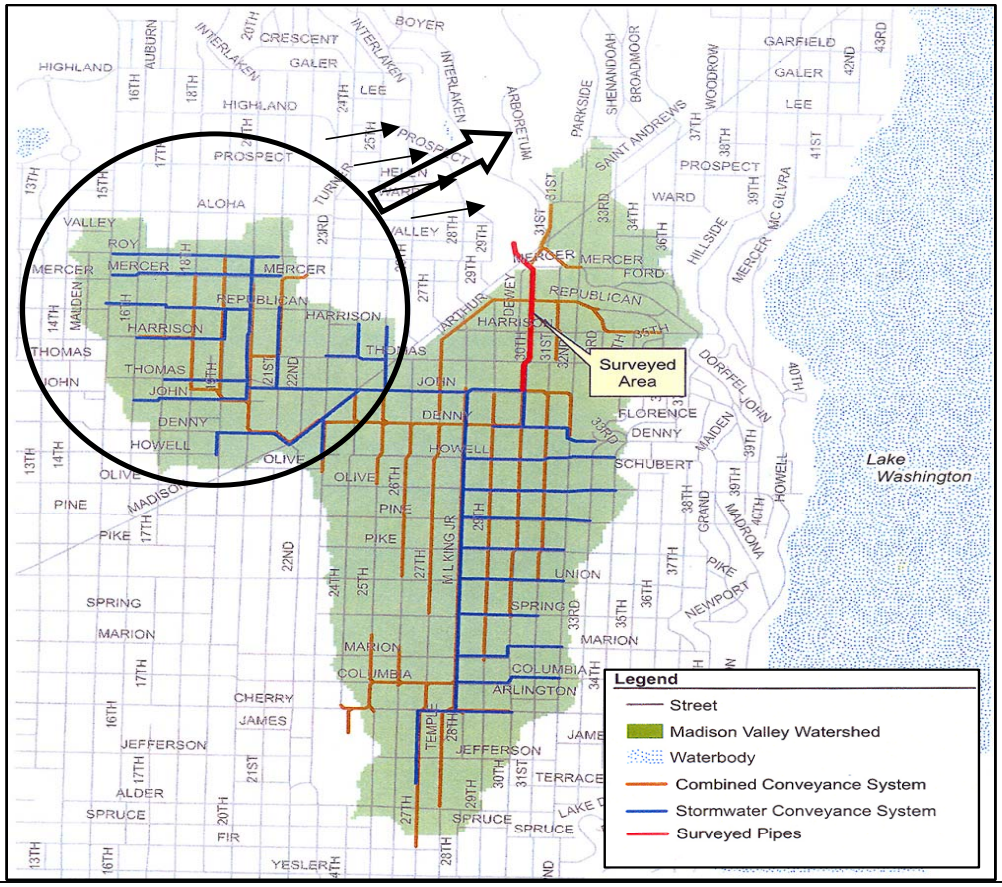

Figure 6. Map of Madison Valley watershed drainage basin. The drainage basin is shaded in green. The orange lines represent the Combined Conveyance system. The blue lines are the Stormwater Conveyance System. All lines lead to the combined sewer line at 30th and E John represented in red. The area circled is the section that residents do not think should be routed to 30th and E John. The small arrows represent the direction of the hillside. The bigger arrow represents the suggestion that this storm and waste water be re-directed north toward the Washington Park soccer field.

c. Information and public involvement

A problem that many residents emphasized was the lack of communication about the interim and long-term solution planning that has been going on since August 2004. I have learned through the interviews and attending ESC meetings that people who made claims for damages after the August 2004

storm and those that were in the direct vicinity of 30th and East John did receive communication about the project in the form of mailings. The people who I interviewed who fell in this category were pleased with the communication and hoped it would continue. However, many of the people I interviewed had not received any information or notice of meetings even though they lived close by and had dealt with significant amounts of water on their property.

> I've never received anything in my mail from SPU saying, "We're talking about drainage issues in Madison Valley and here are some. I've had no communication, but my neighborhood is one of those that flows into the drainage and any solution is going to effect me, either as a ratepayer or as somebody who's going to have to change what I do with my stormwater to deal with their detention pipes.

In the interviews I asked people what kind of information they would like SPU to provide on the project and most stated that they would like more information on the alternatives, since it is often hard to get in the public hearings as some people are still dealing with the immediate need of getting their damage claims settled. One active resident encouraged SPU to put together a website that can be referenced in emergencies and that can allow people to stay apprised of what is happening on the project. A website has since been created and hopefully it will provide the more detailed information residents are looking for.

> They need to be able to explain things in a way that the regular person can understand it... Put together a 3 or 4 page explanation of the differences, advantages and disadvantages of this and the impacts the different alternatives will have on construction and demolition and combination and whatever.

Another resident noted:

> I would like to be around the edges on the engineering details when they're studying the flow of water and all that kind of stuff.

> There isn't enough information. This fundamentally alters all of our lives.

One resident offered a suggestion on the quality of response to public input that he would like to see:

> If they compiled the different kinds of major suggestions and don't discount them immediately and actually listen to them, and provide some real data behind it, so people can counter them, then I think people will feel like they've been heard and don't have to fret around day after day that the City's not doing anything or the City's not responding. Because if you propose what you think is a reasonable thing and it just seems to fall on dead ears and there's no real response back then it's just frustrating and you feel like the process isn't working. And maybe it isn't working, but at least we should have proof that it's working or not working.

Though there were different opinions regarding SPU's prior communication of the project based on where one lives, there was general agreement that people would like as much information as possible on this project from here. Since December 14, 2006, more people in the broader Madison Valley area understand that this is a major problem. Although it is experienced the most in the lowest parts of the valley, the whole watershed contributes to the problem and would benefit from information on the project in order to consider what can be done higher up to mitigate effects during big storms.

CHAPTER 6 CONCLUSION

Urban citizens and Local Ecological Knowledge

In reviewing the interview narratives, it is apparent that the residents of this urban neighborhood possess ecological knowledge of the local environment and the flooding problem that could be helpful to the engineers on this project and other concerned local residents. Many of the participants in this research have a clear understanding of how water moves through their own properties and have

developed a variety of methods to keep their homes as dry as possible. In addition, the participants in this research observe the entire watershed in detail due to their day-to-day experiences in it and their concern for the health of the area they live in. They observe their local surroundings in a broad, holistic context and are capable of developing theories about the long-term viability of human influences on the physical environment. As human communities shift to an understanding that we are a part of the natural environment, not separate from it, the value of the knowledge of long-term residents will hopefully be increasingly recognized. This knowledge provides newer residents and engineers with a multi-faceted environmental history of a particular region, which can help highlight changes that have decreased an area's resilience or capacity to buffer surprise weather events. In addition, historical environmental narratives have the power to create deeper connections between humans and the land in which they live.

Adaptive Management in Madison Valley

Adaptive management is an iterative process and involves a two-way feedback between the management and environmental conditions (Berkes, Folke et al. 1998). In a compact, urban area like Madison Valley many complex and unpredictable interactions exist between local governments, ecosystems, and individual citizens as they evolve together. Due to this complexity, a more adaptive approach to water management is appropriate for SPU's project in Madison Valley.

Residents have observed feedbacks such as overflowing storm drains, water tables that seep up into basements, and the historically marshy conditions in

Washington Park and in their own yards. If SPU's long-term solution only involves bigger pipes and tanks, the ability of local citizens to contribute experiential observations will be severely challenged. As a result, as the planet gets warmer and population in this region grows, it will be much harder for the community in this watershed to understand when the utility infrastructure is reaching a breaking point as it did on December 14, 2006. An example of adaptive management is represented in utility projects in Seattle that have employed methods to allow some portion of stormwater to flow above ground. The restoration of natural streams and creeks is helping residents to understand how much water moves through their home region. If people do not see the flow of any water, they are less likely to think about monitoring the stability of their foundations, retaining walls, and storm drains as they degrade over time due to the natural movement of water, trees, and falling leaves.

A shorter-sighted solution that attempts to define the ecosystem at a certain stage of natural change and does not allow for feedback mechanisms will block out environmental variability and the ability to perceive smaller feedbacks. This invites larger and less predictable feedbacks at a level and scale that threaten the functionality of the whole drainage basin. Thus, a key factor in successful adaptation to the variables of climate change and population growth in Madison Valley will be the presence of appropriate feedback mechanisms which provide an opportunity for management decisions that can be monitored to influence the next set of decisions. A few historical factors that challenge the environmental feedback process in Madison Valley include the dam under Madison Street and a heavily paved watershed. However, the severity of the surprise storm event on

December 14, 2006 has triggered increased learning on the part of the local citizens. Many residents recognize the need for a re-designed water management system in the Madison Valley watershed that offers opportunities for feedback and adaptation that will ultimately help the local residents and government agencies to create a more sustainable neighborhood.

Environmental Justice in Madison Valley

As stated earlier, the environmental justice framework helps us to interpret the historical context of the flooding problem in this area. Now that the inadequate utility infrastructure is being addressed, we can use the environmental justice frame to look closer at other factors that exacerbate this problem. Residents have noted that the rapid loss of permeable surfaces on the hillsides in recent years combined with more storm and wastewater from high-density development has increased the volume and likelihood of flood events in the low-lying sections of the watershed. Continuing to allow this loss of absorption without creating and communicating a plan for mitigating it is today's environmental injustice. The residents of Madison Valley understand the need for density and the curbing of sprawl. However, it is not appropriate to move forward on this goal before infrastructure is in place to protect an established neighborhood that is already susceptible to flooding.

Environmental Justice, LEK, and Sustainability

The Madison Valley residents who mobilized and went to meetings to express their frustration over the flooding of their basements with combined water and sewage paved the way for the City's current project and the whole community can be thankful for that. Since the community has been successful in

garnering the attention of the appropriate agencies to help address this environmental problem, obtaining the LEK of the community is an important next step. In Madison Valley, the community and SPU will be better able to define a solution that all stakeholders can accept, if there is an open exchange of knowledge between parties. Involving the entire drainage basin in communications regarding the project may solicit valuable knowledge and suggestions. In addition, the larger community will develop a better understanding of the problem and may understand the need to capture stormwater on their property. Some authors believe, "sustainability will be achieved, if at all, not by engineers, agronomists, economists and biotechnicians but by citizens" (Prugh et al *in* Agyeman 2005:5). Government policies and regulations alone are not capable of creating sustainable communities. The creative ideas for an area will more naturally come from those living in that community. Thoughtful modifications will need to be made by citizens as well as governments to help create urban neighborhoods that are resilient to the changes encouraged by global warming and higher population density.

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