Addressing Flooding Issues in an Environmental Justice Community: A Complicated and Multi-Layered Case Study

Mahbubur MEENAR, Ph.D., Temple University, USA

Jeffrey FEATHERSTONE, Ph.D., Temple University, USA

Jamie MAGAZINER, MS, Temple University, USA

1. Introduction

How to address recurrent and severe flooding issues in a community subjected to significant environmental justice (EJ) concerns? What should be the role of the surrounding communities? This paper presents a unique and complicated case study while addressing these broad questions. It focuses on a metropolitan watershed around a historic town (incorporated in 1888), located close to the City of Philadelphia, USA. It describes the process of developing a flood and stormwater management plan for the whole watershed, with a specific emphasis on the EJ community.

The term “environmental justice” was created in response to the increased prevalence of toxic pollution and its disproportionate impacts on poor, minority communities (Holifield 2012). EJ is defined as the fair distribution of environmental risks and hazards among all groups based on race, class, ethnicity and economic status. Environmental injustice is commonly described as certain disadvantaged groups of a population baring a disproportionate burden of environmental hazards. The scope and range of EJ literature has evolved greatly since the origin of the term in the early 1980s. An EJ movement was born when a PCB landfill was set to be built adjacent to the homes of mostly low income African American residents in Warren County, North Carolina (Bullard 1993; Schlosberg 2007).

Over time, the scope of the literature has not only broadened to include various social groups, but also the various issues that can be associated with environmental hazards, including flooding (Holifield et al. 2009; Walker 2009; Walker and Burningham 2011). More recent natural disasters, such as Hurricane Katrina, lead the literature to look more closely at natural hazards as well as technological ones, which dominated the field for a long time (Colten 2007; Morse 2008; Stivers 2007; Sze 2006). Flooding is a significant component of this small but quickly growing body of work. Within this work flood risk is being framed as a potential component of environmental inequality and injustice (Walker & Burningham 2011). While a small group of literature exists on flood risk and its associated environmental justice issues, further research is needed as flooding issues grow worldwide.

The literature has also expanded to look at environmental justice as a multi-dimensional concept (Martin et al. 2014). Researchers look at EJ as having three main dimensions. These dimensions are: distribution, recognition, and participation (sometimes referred to as procedure). Early in the literature, distribution was commonly discussed and dominated the field (Walker 2012). Distributive justice refers to the “distribution of goods and bads” between different individuals and groups and has dominated environmental justice debates to date (Walker 2012). The field expanded to eventually include the dimensions of recognition and participation (Walker & Burningham 2011; Holifield 2012). The dimension of participation, commonly referred to as procedural justice, deals with the level of inclusion of individuals and groups within the decision-making process as well as who guides the process itself (Martin et al. 2014). Procedural justice is commonly defined as “the fair and equitable institutional process of a State” (Urkidi et al. 2011). Recognition acknowledges personal dignity of all individuals (Fraser 1995), collective identities and their needs or concerns (Staeheli 2008) or the overcoming of institutional harm to social status (Tschakert 2009). This dimension examines the role of history and process and evaluates the causes and consequences of environmental inequity (Pellow 2000; Sze 2007).

2. Context

The densely-developed West Ambler neighborhood, located in Whitpain Township, Pennsylvania and characterized by a low-income and minority population, has vacant and flood-damaged properties. The neighborhood faces environmental justice issues that include air pollution, surface water pollution and groundwater contamination. As seen in Figure 1, sections of Ambler Borough and the West Ambler section of Whitpain Township are located at the downstream end of the tributary watersheds and are subject to the accumulated effects of increased runoff from upstream areas. In addition, these areas are impacted by flooding from the main stem of the Wissahickon Creek. In addition, the West Ambler neighborhood includes the BoRit Superfund Site, which includes a six acre private tract with asbestos piles, a 15-acre reservoir, and an 11-acre park that has been closed due to asbestos contamination. Another site, the Ambler Asbestos Piles, is also located in close proximity to the EJ community.

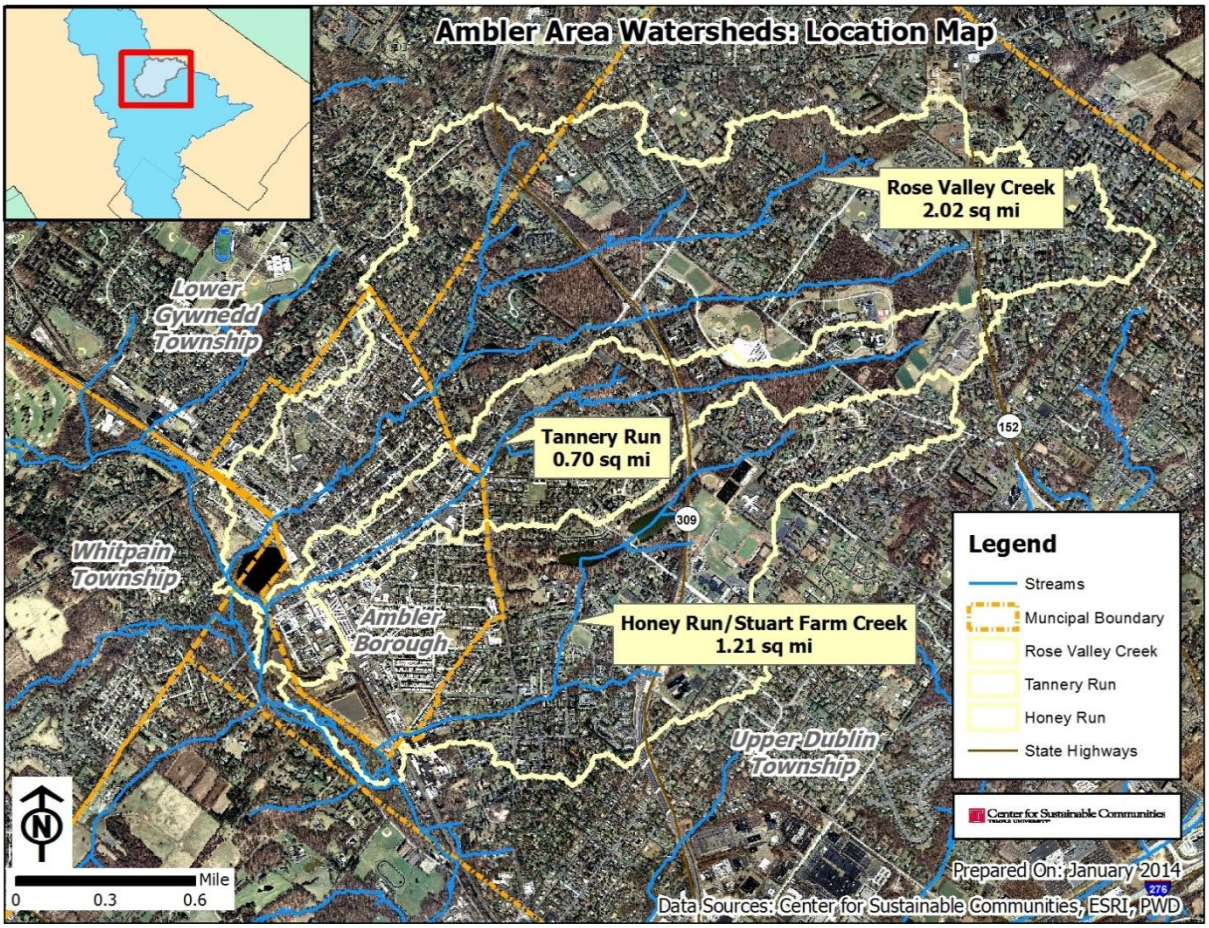

Figure 1: Study area

Ambler Borough has had a long and unique history of asbestos production and contamination that stretched from 1897 to the 1980s (CEET, Ambler n.d.). The superfund site has had a legacy of producing and serving as a dumping ground for asbestos products. It was selected for the Environmental Protection Agency's (EPA's) National Priorities SUPERFUND List in 2008 (CEET, Ambler n.d.). It is a high priority due to its proximity to several water bodies (Tannery Run, Rose Valley Creek, and the Wissahickon Creek) in addition to residences. Residents of the community have voiced their concerns about the site for several decades.

Communities in the Wissahickon Watershed have faced devastating effects from major flood events (Floyd 1999, Allison 2001, Ivan 2004, Irene 2011 and Lee 2011), and

have faced millions of dollars' worth of damage as well as loss of life. For the main stem of the Wissahickon Creek in Montgomery County, each of these events produced peak flows larger than the 100-Yr flood used for the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs). While flooding is a natural process and occurs in both developed and undeveloped watersheds, land conversion to less-permeable surfaces in the absence of stormwater controls leads to higher flood peaks, flood volumes, and frequency of flooding. This is of particular significance in the West Ambler neighborhood, where more severe impacts have been observed.

Environmental justice issues helped launch the Ambler flooding study. In 2011, Whitpain Township had received $250,000 in streetscape funding from the Pennsylvania Department of Community and Economic Development to replace sidewalks in West Ambler. After the two storms and local devastation, West Ambler residents successfully argued that the flooding issues should be addressed before replacing the sidewalks. As a result, in 2012, the township engaged the Center for Sustainable Communities (CSC) to perform the flooding study for the Ambler area and the firm of Simone-Collins to prepare a revitalization plan for the neighborhood. The CSC created a Project Team of university researchers to perform the study.

The Project Team's discussions with community groups indicated that the disadvantaged West Ambler neighborhood faces severe flooding and poor water quality due to contamination from the asbestos site, posing a serious environmental justice problem in this watershed. Through this work, the interests of both the residents of the West Ambler neighborhood, who are disproportionately impacted by flooding, health risks, and floodplain map revision, and the surrounding communities of the Ambler Borough and Upper Dublin Township, must be balanced accordingly.

3. The Project

3.1. Initial Community Outreach

At the very early stage of this project, the team met with officials of the three municipalities, and representatives of environmental groups and community organizations. Ambler Borough officials indicated that mitigating recurrent flooding, managing stormwater and improving water quality are critical challenges to achieve a better quality of life for its residents. Whitpain Township officials said that emergency response, flooding mitigation and community revitalization are community priorities. Stormwater management and flood mitigation are longstanding priorities of Upper Dublin Township, which is implementing several stormwater improvements identified in a previous CSC project. The project team's discussions with local environmental councils and organizations indicated that the disadvantaged West Ambler neighborhood faces severe flooding and poor water quality due to contamination from the asbestos site, posing a serious environmental justice problem in this watershed.

The Project Team used outreach activities and stakeholder meetings throughout the two-year project period. A 24-member Watershed Plan Advisory Committee was formed in September 2012 consisting of representatives from government officials, municipal authorities, professionals, environment advisory councils, civic associations, environmental associations, business community and local residents. A project website (http://amblerwatersheds.wordpress.com) was launched in mid-September of 2012. The web site included project-related basic information, community priorities and challenges, and an online form for public input.

A "municipal problem area" survey was conducted in 2012. Municipalities within the watershed identified 163 locations where flooding, erosion, and sedimentation were occurring. Information on drainage problems and proposed solutions was solicited from each municipality by providing forms for each Advisory Committee member. The project Team studied local plans, projects, and initiatives addressing stormwater management and flooding issues throughout the study area. Examples included *Ambler 100 Rain Gardens*, *Rose Valley Creek Riparian Buffer Restoration*, and *West Ambler Revitalization and Action*

Plan, which focused on the BoRit Superfund Site and proposed channelization or day-lighting of the Rose Valley Creek.

A public stakeholder meeting was organized by the Project Team with the help of the Advisory Committee. Following intense advertising and outreach efforts, approximately 115 stakeholders attended the meeting, held in a venue located within walking distance of the EJ community. After an hour-long open discussion, the stakeholders of three municipalities (Ambler Borough, Upper Dublin Township, and Whitpain Township) staffed three separate stations in the venue to share their experiences with recent flooding events. They responded to a number of questions included in a survey. This session was facilitated by 15 volunteers from local municipalities and Temple University.

All attendees agreed on the importance of addressing the flooding and stormwater issues this area has been facing for decades. Nearly all of the respondents (90%) reported that their properties have been flooded at least twice in the past 10 years, with 52% of respondents reporting their properties have flooded five or more times in the past 10 years. Some respondents even reported that their properties flooded twice a year. Slightly more than 40% of respondents reported having flood insurance. More than two-thirds of respondents described flooding of their basements, incurring the loss of various appliances and personal effects. Many respondents also detailed structural damage to their finished basements, including damage to drywall and carpeting. Damage to exterior features, including landscaping, sidewalks, or driveways was also described. For some, flooding was so severe that vehicles parked on the street and in driveways were totaled.

Just over half of the respondents reported either taking action themselves to mitigate future flooding or knew that their municipality was taking action. Most reported that they had taken action themselves on-site: some of these actions included the installation or upgrading of sump pumps, different types of drains and drain pipes, berms, and reinforced or glass-block basement windows. Actions taken by municipalities that respondents described included commissioning studies, widening riparian buffers and replacing culverts. Many ideas and suggestions were offered as to what could be done to mitigate flooding in the future, ranging from the general to specific. Many respondents supported, in general, the restoration of riparian buffers and wetlands in the area, as well as improving existing detention basins. Some suggestions directly related to the pipes running under regional rail tracks, indicating that they should be replaced or redone. The installation of storm sewers and detention or retention basins on specific locations were also recommended.

3.2. Understanding the Watershed

Stormwater management planning must take numerous surface features into account, including topography, soils, land use, and impervious cover, as well as existing stormwater collection and discharge. Since the Ambler area watersheds are located at the center of Wissahickon Creek Watershed, a broader understanding of the Wissahickon Watershed was needed, especially for continuous data sets such as precipitation. Primary data were created by the Project Team and its sub-contractors. Secondary data were collected from various sources. After field verification of secondary data, which was complete by January 2013, the Project Team decided that some data needed enhancement and new ortho photography and elevation data were created and used in the analysis.

The Project Team conducted GIS analyses regarding watershed characteristics and runoff, including flash flood potential, land use, and precipitation. Analyses were also conducted in order to further understand stormwater and flooding issues in the area. The results of this assessment follow.

The Wissahickon Watershed is vulnerable to heavy rainfall from tropical weather events. Damaging tropical storms in recent years have included Floyd (1999), Allison (2001), Ivan (2004), Irene (2011) and Lee (2011). For the 30-year period from 1981 to 2010, precipitation at the National Weather Service (NWS) rain gage at nearby Springhouse averaged 47.4 inches[i]. This annual total, however, is not uniformly distributed over time and space, and extreme events can produce eight inches of rain or more in some areas in a single day. Although extreme storm events trigger the most damaging flooding in the

Wissahickon Watershed, most storms produce less than one inch of rainfall. These smaller storms produce a significant portion of annual runoff. For this reason, stormwater management measures designed for infiltration or extended detention of these smaller runoff events are effective in reducing non-point pollution loadings and stream erosion.

The elevations over the watershed range from 155 feet to 397 feet. The EJ community has the lowest elevation values. Runoff characteristics of various land uses vary with the underlying hydrologic soil group designation, and information on the location of hydrologic soils groups was used in the hydrologic modeling for this study. Hydrologic soils in the most part of Ambler area watersheds have medium to high runoff potential with low infiltration rates. Almost half of the study area has single-family detached residential land use, and about 7% is multi-family residential. The National Weather Services' Mount Holly Weather Forecast Office has conducted a GIS-based analysis of flash flood potential, based on digital data available for soils, slope, forest density, and land use. According to this data, the EJ community and surrounding areas have highest flash flood potential.

Based on field observations, digital ortho-photos, land use data, and outfall and drainage data provided by the Philadelphia Water Department (PWD), it was estimated that stormwater collection systems of various capacities have been installed in most of the study area, although many places have poor drainage. Based on field visits, the Project Team concluded that many existing detention basins within the watershed were not properly designed to address small storms, and runoff from these storms passes directly through the facilities. These structures represent opportunities for retrofitting to provide additional storage, infiltration, and extended detention.

Stormwater problems are created because of increased impervious cover, destruction of riparian buffers, extensive floodplain development, more frequent extreme precipitation events, extensive channelization and piping, higher peak flows, higher runoff volumes, loss of upstream storage, erosion, and obstructions to flow. Water quality problems are due to both point-source and nonpoint-source pollutions. All three creeks in the study area are designated as "impaired" in Pennsylvania's regulatory 303(d) list due to siltation, caused by urban runoff/storm sewers and habitat modification. Surface water quality is impaired from a lack of stormwater runoff management and nonpoint source pollution control. The Ambler area was almost completely developed prior to the Pennsylvania Stormwater Management Act of 1978 and lacks suitable runoff controls (PWD, 2007). Analyzing data created by the Heritage Conservancy, the Project Team concluded that increasing urbanization in the watershed has led to the destruction of riparian buffers, which has increased erosion and sediment loadings, leading to the widespread loss of habitat for both aquatic and terrestrial species, as well as propagation of invasive plant species. In terms of point source pollution, the Superfund Site was discussed in a prior section. Another source of pollution is contamination from wastewater treatment plant discharges and infiltration and inflow from sewer lines during storm events.

The study area has experienced severe flooding in many recent storm events, including Hurricane Irene and Tropical Storm Lee in 2011. Both storms produced peak flows larger than the 100-Yr flood used by FEMA as the basis for the current FIRMs. According to existing FEMA FIRMs, 101 building structures have been identified within 100-Yr floodplains and 163 structures within 500-Yr floodplains. There are many locations in this study area where existing FIRMs have become outdated. Figure 2 shows such as area (in a red dotted circle) that has faced severe flooding in recent large storm events, but is not inside FIRM flood-zones. Based on individual flood insurance claims data provided by FEMA, the highest density of claims has been in the lower reaches of the three tributaries within Ambler Borough (including the EJ community), with very few occurring in the headwater areas. According to FEMA statistics as of December 31, 2013, a total of 179 flood insurance claims had been filed in Ambler Borough alone with 157 of these claims paid, for a total payment of $4.02 million since the start of the flood insurance program in 1978.

3.3. Engineering Models and Outputs

The Project Team used ArcGIS, HEC-HMS, and HEC-RAS software to conduct hydrologic and hydraulic modeling for portions of the Wissahickon Creek and three tributaries (Rose Valley Creek, Tannery Run, and Honey Run/Stuart Farm Creek) within the study area. The CSC is a FEMA cooperating technical partner (CTP) for floodplain mapping and has approved floodplain maps created by the CSC in recent years for other watersheds in the region (i.e., Pennypack and Sandy Run). New 100-Yr and 500-Yr floodplains for this area are preliminary pending final approval by FEMA.

Model results for the design storms were generated after calibration of the hydrologic model. The model outputs included peak flows, flow hydrographs, and runoff volumes for subbasins, junctions, and stream reaches. Two versions of the model were used in the study. Model outputs for current conditions were used to generate peak flows for determining flood elevations and flood maps. A second version was developed to represent future conditions assuming that upstream stormwater improvements proposed in this study would be put in place. .

Figure 2 shows a comparison of FEMA and preliminary CSC 100-Yr floodplains for the study area. A significant portion of floodplains for the Rose Valley Creek in the West Ambler neighborhood (inside EJ community) was not previously mapped and is not included in FEMA's existing flood insurance rate map. This high hazard flood area is now included in the new preliminary maps and flood prone structures will become eligible for federal buyouts. In addition, most of the upstream portions of the tributaries were not included in FEMA 100-Yr floodplains, but are now within the new mapped areas. According to this new delineation, 136 structures are within 100-Yr floodplains (previous number 101) and 212 structures are within 500-Yr floodplains (previous number 163).

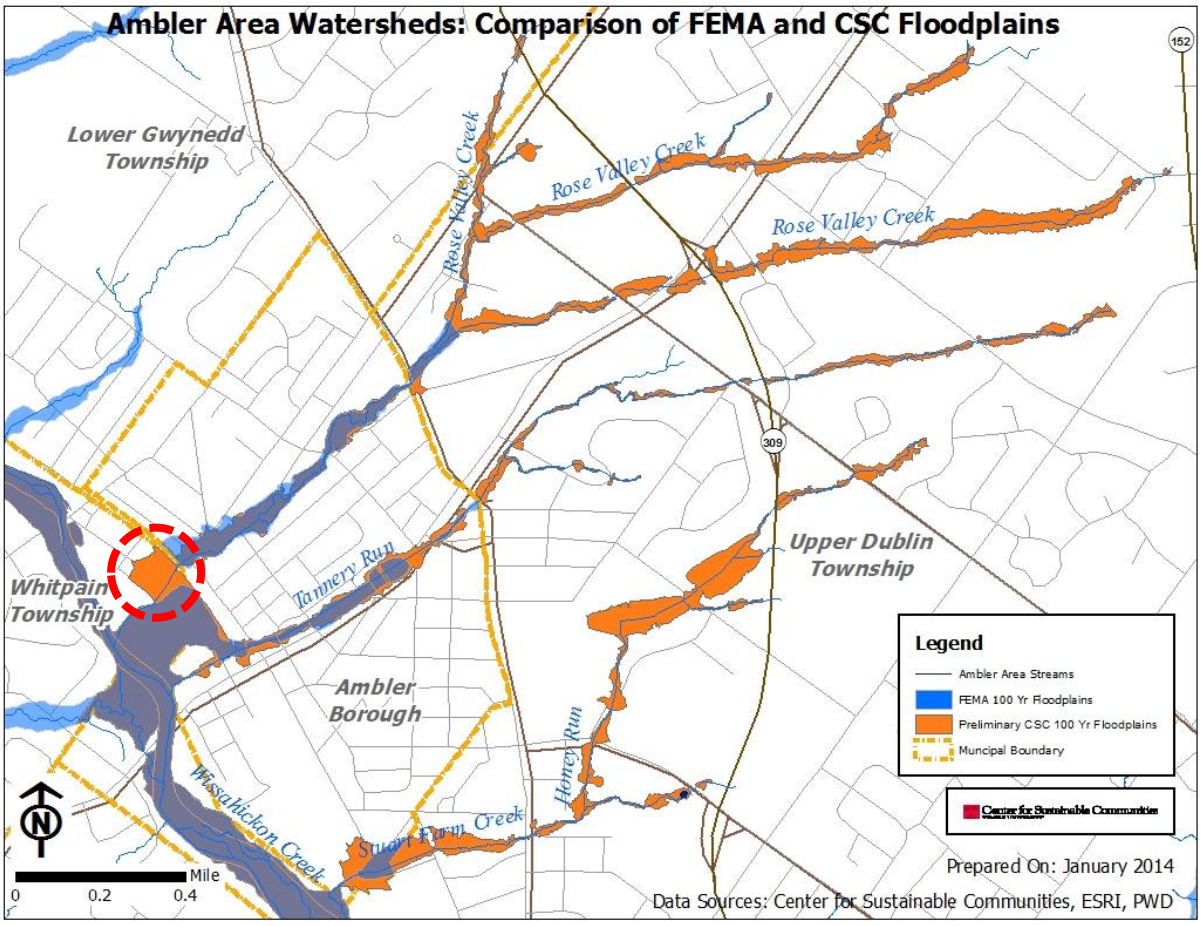

Fig 2: FEMA and preliminary CSC floodplain comparison

3.4. Stormwater Management Recommendations

Based on input from municipalities, community residents, and environmental groups as well asthe field surveys, watershed assessments, and hydrologic and hydraulic modeling performed for the study, the Project Team recommended location-specific stormwater infrastructure (SI) facilities throughout the study area. In order to reduce runoff peaks and volumes, and address the widespread water quality impairments caused by stormwater runoff in the study area, various types of opportunities for improvements were evaluated, including but not limited to retrofitted detention basins, infiltration galleries and trenches, constructed wetlands, rain gardens, pervious paving, day-lighting streams, and riparian buffer. These recommendations are consistent with community needs, and community projects, initiatives, and plans.

As this watershed is essentially "built-out," the Project Team concentrated much of its research on identifying opportunities for retrofitting existing stormwater facilities and finding locations for new SIs in areas not currently served by them. Additional flood control or mitigation options for the West Ambler neighborhood (EJ community) were evaluated. Because structural measures such as channel expansion and culvert enlargement can reduce floodplain storage and increase flows downstream, it is important that these measures be completed in combination with other stormwater control measures (i.e., stormwater best management practices – BMPs) that increase upstream storage. This approach would help prevent adverse downstream impacts.

After identifying potential SI projects and their possible locations, the Project Team assessed the hydrologic and water quality impacts of the proposed improvements. The proposed SI improvements were incorporated into a "Future Conditions" HEC-HMS model run, following same modeling approach described in previous section. In some locations downstream from potential improvements, the reduction in peak flow rates is sufficient to reduce water surface elevations for smaller storms. The combined potential additional storage provided by the three categories of improvements was estimated at 98.6 acre-feet, or approximately 33 million gallons. This volume of storage is equivalent to 0.47 inches of runoff from the 4 square mile watershed. The reductions in peak flow and volume would help reduce scour and erosion potential along stream reaches, and would be helpful where stream restoration is planned or has been completed. In addition, the recommended projects would provide for settling and storage of sediment in runoff and reduce sediment loading in the watershed. To provide a means of prioritizing further investigation of the proposed improvements, each site was rated based on three factors: (a) Effective use of additional storage during small storms – 50 percent weight of the total score; (b) Cost per acre-foot of storage provided by the site – 25 percent; and (c) Location in the watershed, with the upstream portion of the watershed receiving the highest score – 25 percent.

Recommendations include some structural measures within existing downstream floodplains. While such measures substantially lower flood risk, flooding would still occur if storms exceeded the design of the control measure. For the lower Rose Valley Creek analysis, the 500-Yr storm was used to determine the size of the enlarged channel, which would significantly reduce flooding in the West Ambler neighborhood. The Project Team recommended the site-specific projects only if the water released would be compensated with upstream storage or infiltration. All these recommendations were consistent with community input as well as the *West Ambler Revitalization and Action Plan*. Some of the site specific recommendations would impact many building owners. However, through daylighting the stream, the area subject to flooding could be greatly reduced, particularly in the West Ambler EJ community. While some properties would be impacted by this process, the damage inflicted overall by flooding would be cut back significantly.

The implementation of low-impact SIs will not likely impact flood control to a significant extent, due to their limited size, but have been proven to significantly improve water quality on a local scale. The placement of 5,940 rain barrels would absorb on average 1 acre-foot of rainwater and 100 rain gardens of 200 cubic feet each would absorb 0.46 acre-foot. Such projects may reduce stormwater marginally, but improve water quality by catching rainwater before it is polluted (rain barrels), by filtering pollutants out, or a

combination of both. In the case of rain barrels, the water can be reused for several household purposes.

3.5. Implementation Plan

After presenting the findings to municipal officials and Advisory Committee members, the following implementation strategies were proposed to the municipalities: the adoption and enforcement of new Flood Insurance Rate Maps (FIRMs), implementation of the stormwater improvements and flood control projects, adoption of municipal stormwater ordinances, institution of a flood warning system, and participation in FEMA's Community Rating System (CRS).

The municipalities were encouraged to independently or jointly submit the proposed new FIRMs to FEMA in the form of a letter of map revision (LOMR) and to adopt them as "best available information" for floodplain management purposes until the new maps are formally approved by FEMA and subsequently by the municipalities. The federal flood insurance program provides funding for voluntary buyouts of flood-prone properties. This plan identified several candidate properties. Typically, the federal government through FEMA provides 75% of the funding for property acquisition with the remainder of the funds coming from state and local government. The designation of properties as residing in a flood hazard zone through adoption of FIRMs is a critical step in the buyout process.

The municipalities were also encouraged to construct the stormwater improvements identified in this plan by increasing each municipality's capital improvement program funding. The various improvements were assigned a priority according to their location, cost – effectiveness, and capture potential, and municipalities could use this ranking as a basis for funding projects over a long-term period. Various state-level and local funding sources were listed. Flood control projects are eligible for federal funding. The three municipalities were encouraged to participate in the National Flood Insurance Program's (NFIP) Community Rating System (CRS) to get discounted flood insurance premium rates. A flood warning system for small watersheds requires forecasting, rainfall and water level monitoring, and response when flood rainfall rates or levels are triggered. The plan included initial recommended steps for the municipalities.

3.6. Post-Study Community Outreach

In March 2014, an early draft version of the final report was submitted to three municipalities (Ambler, Upper Dublin, and Whitpain) and Advisory Committee members for review. Based on feedback, corrections were made and a final draft version was prepared and eventually shared publicly in October 2014. An interactive online GIS map (http://goo.gl/6yZBNG) was published showcasing the comparison of existing FEMA floodplains and the new floodplains. Six weeks were allocated for public reviews and comments on the draft plan. Comments were received via emails, phone calls, and even personal visits. In late November the Project Team presented the study results in front of about 100 community residents, business owners, and other stakeholders (including federal, state, and local agencies) in a location within walking distance of the EJ community. Majority of the comments were received during and right after that presentation.

The presentation event transitioned into an interactive open conversation between the residents and the Project Team, the municipalities, and federal government agencies. Among the many Ambler Borough residents who have been subject to the accumulated effects of increased runoff, the concern of property damages caused by flooding being comprehensive and significant was greatly expressed. Indisposed with anticipation to address such concerns, the microphone wove through the audience as residents shared specific questions, suggestions, and comments. The Project Team received two general types of comments: informational and concerns or suggestions.

The informational comments were both general and study-specific. The general comments included questions regarding terminology (i.e., daylighting, floodplains), funding/ implementation/ timing, stormwater ordinances, and proposed developments in the area. The study-specific comments mentioned were questions about details of the SI projects and

explanations of the floodplain changes. At the public meeting, a resident questioned why most of the properties being removed from the floodplains after the stormwater measures were commercial and not residential. Several residents posed questions about plans for the development of a four-house subdivision in the Rose Valley Creek watershed and whether the study considered these plans.

The concerns and suggestions received can be broken into three primary categories: a) floodplains, b) stormwater management projects, and c) miscellaneous. Comments about the newly delineated floodplain maps were major concerns and/or opposition about individual properties being included in the preliminary floodplains. Concerns were related to expensive flood insurance, loss of property values, and restrictions on home improvement within flood zones.

Residents were informed that the Project Team used latest technology and data available for floodplain mapping and that they followed all the established standards and protocols set by FEMA. They were also informed that these preliminary floodplain maps would be scrutinized by FEMA and the Army Corps of Engineers (ACE), then revised by the Project Team if needed. On the other hand, many residents were delighted by seeing their houses or properties in the new floodplain maps. They acknowledged that this is the correct information. Some people commented that if they live in a high-risk flood area and are now required to get insurance, they will actually be able to purchase the flood insurance (because, according to the respondent, they are having problems getting the insurance), so “this is a win-win situation”.

There were concerns and suggestions in regards to the specific stormwater management projects proposed in the study. Residents questioned why certain areas and projects were or were not included and offered ideas for other projects to be considered. Some raised concerns about property acquisition. Based on public input, three additional site-specific SI facilities were included in the final report. There were only minor comments on the proposed detention basins, infiltration areas, and riparian buffer areas.

The remaining concerns and suggestions were on miscellaneous topics, such as problems related to FEMA flood insurance program, removal of the asbestos dumps that could free up over 70 acre feet of much needed lands for flood waters, and consideration of proposed developments in the engineering models. The Project Team forwarded the comments related to flood insurance program and superfund sites to FEMA and EPA respectively. Proposed developments were not considered in engineering models. The watershed is almost completely built out, so models were run considering the fact that land use would be mostly unchanged.

4. Conclusion

The Project Team used various community engagement tools throughout the Ambler study, including stakeholder meetings, surveys, websites, and direct interaction. While these tools were not specifically designed for addressing environmental justice questions, they were very useful for this purpose because the West Ambler community was specifically targeted by the project team and municipal officials for input and engagement. The Team’s experience with this study strongly suggests that direct contact with residents is preferable to the other tools as it enabled us achieve an initial level of trust with local citizens.

The municipalities also engaged the West Ambler community, which enhanced our study efforts. Whitpain Township created a West Ambler Revitalization Committee that includes local residents as well as officials. The committee meets quarterly at the municipal building. The township also holds quarterly public meetings in the evening with local citizens in West Ambler. At both venues, Project Team members briefed municipal officials and local residents on the status of the flooding study. These meetings provided an opportunity to directly engage local residents and receive more exposure and input for our study. Ambler, Upper Dublin, and Whitpain also participate on the BoRit Citizens Advisory Group created to advise EPA of actions taken at the Superfund site adjacent to the West Ambler neighborhood. The group, which meets monthly, includes over twenty members including the West Ambler Civic Association.

Sometimes community engagement raises difficult issues that might not have surfaced without it. Engagement does not always lead to public support. The flooding study led to the identification of many flood hazard areas that were not delineated on FEMA floodplain maps. While helping flood-prone homeowners better understand their flood risks, this information and designation as flood prone also was disconcerting to many Upper Dublin residents as their properties undoubtedly would be perceived as less valuable. At the stakeholder meetings several homeowners expressed this concern and sought to challenge the entire study. In contrast, community engagement was clearly positive for West Ambler as the routinely flooded sections of the neighborhood had not been officially mapped as flood prone and homes were not eligible for technical assistance and buyouts. The study and maps provide the means to make this happen.

The Ambler flooding study was conducted as a partnership between Temple University and the three municipalities. While funding was derived from multiple sources, the individual contributions of the municipalities and their willingness to hire the university were critical factors in securing financial and political support for the study. The university began forming these watershed partnerships back in the 2003 when it enlisted eleven municipalities to help finance a flooding study for the Pennypack Creek Watershed, also in suburban Philadelphia. The university raised $100,000 from them, which it used to secure over $1 million in funding from other sources, including a foundation and several federal and state agencies. Subsequently the university forged several other multi-municipal studies, including the Ambler Flooding study. Why has this been successful? This is most likely due to the Team's neutral/ independent status, student involvement, and comparatively lower cost may be contributing factors.

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