CHAPTER 2 STORMWATER MANAGEMENT CHALLENGES AND OPPORTUNITIES

The concept of stormwater management has evolved over time as the City of Bellevue has developed and as issues associated with runoff have changed. This chapter describes the history of Bellevue's stormwater management, and highlights the challenges and opportunities that lie ahead.

Nature of Stormwater

Stormwater is a term that describes water that falls as rain or snow and then either infiltrates into the ground or flows across the land surface or through a conveyance system (constructed pipes or ditches), until it reaches a receiving water body (lakes, streams, wetlands). Stormwater is both a resource and a nuisance. It provides flow to streams, lakes, and wetlands, and replenishes groundwater supplies. It also collects and transports pollutants from the surfaces it flows across and deposits them in streams, lakes, and other water bodies. Stormwater also contributes to flooding and streambank erosion when flows are large or prolonged.

Stormwater is everywhere, following the topography from high points to low, and crossing jurisdictional boundaries and property boundaries. Stormwater flows from one property owner to the next and each owner bears the responsibility to receive and convey stormwater across their property downstream to the next. Property owners take different approaches to managing the runoff, and stormwater management philosophies and techniques have changed over time. Today's stormwater system reflects these various management approaches. It is a combination of open infrastructure such as ditches and streams, and closed infrastructure that largely consists of collection points (catch basins), conveyance pipes, and culverts under driveways and roads. Since the 1970s, many best management practices (BMPs) have been used either as a single technique or in combination to address problems related to stormwater, including flooding, pollution, and erosion. While there are options available to manage stormwater (i.e., pollutant source control, runoff treatment, and maintenance of conveyance systems), some elements are beyond the City's control, including the timing, duration, and magnitude of rainfall or the air deposition of pollutants, such as mercury.

History of Stormwater Management

Management of stormwater is a relatively recent concept. The Bellevue Storm and Surface Water Utility was the first fully operational stormwater utility in the nation, established only 36 years ago. Bellevue was incorporated in 1953 (population 6,000), more than a decade *after* the construction of the I-90 floating bridge (1940), and a decade *before* the completion of the SR 520 floating bridge (1963). During this period, Bellevue's population grew from 6,000 to over 14,000. By the time the Storm and Surface Water Utility formed in 1974, the city's population was 63,940. At that point, 38 percent of the area within the present city boundaries, which includes areas that would later be annexed, was already developed.

As described in Chapter 1, the original focus of the Storm and Surface Water Utility was to provide control of stormwater to reduce flooding, erosion, and property damage; prevent the deterioration of water quality; and construct regional detention ponds to remediate previous development. Streams, lakes, and wetlands were to be used as integral parts of the stormwater system. Some of the major drivers and events for stormwater management in Bellevue are illustrated in Figure 2-1.

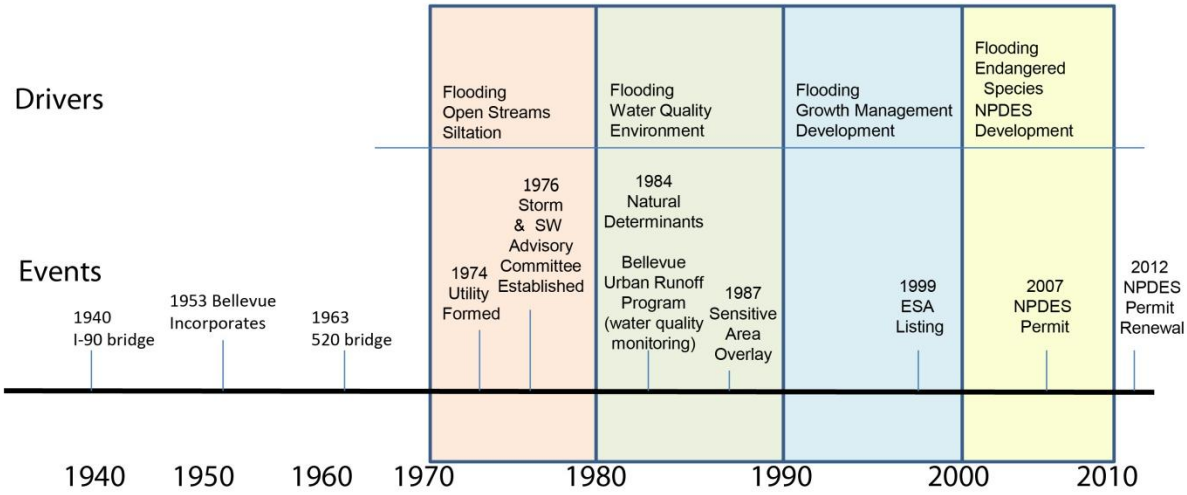

Figure 2-1. Timeline of stormwater-related drivers and events.

Figure 2-1 shows the chronology of a few key activities affecting stormwater management. These actions included:

- 1974–Storm and Surface Water Utility formed. Established local funding mechanism for stormwater management.
- 1977, 1981, 1988, 2008–Voters approved parks bond measures. Allowed purchase of open space and natural areas, protecting forest cover, wetlands, lakes, and streams.
- 1979–Drainage Master Plan, a city-wide assessment of flows and potential flooding concerns that included a phased approach to capital projects, was adopted by the City Council.
- 1984–Original Storm and Surface Water Utility Phase 1 land purchase and regional pond construction was completed. Acquired significant areas of wetlands and constructed additional stream flow storage to remediate runoff from previous development to reduce flooding and erosion.
- 1984, 1995–Bellevue participated in national urban runoff program and then conducted second monitoring assessment to detect changes. Provided scientific characterization of pollutant levels running off urban development. Identified target pollutants for local education and remediation efforts.
- 1987–First Sensitive Areas regulations established. Provided regulatory protection for streams, floodplains, wetlands, and steep slopes, as development occurred.
- 1995–Regional Needs Assessment was approved. Established a regional funding approach to large river flooding, water quality issues in shared water bodies, and salmon recovery.
- 2007–Bellevue was issued a Phase II municipal stormwater permit under the National Pollutant Discharge Elimination System (NPDES). Established city-wide requirements for pollution prevention under the Clean Water Act.

A large portion of the city had been developed prior to the formation of the Storm and Surface Water Utility and the application of storm and surface water regulations, which have evolved over time (Figure 2-2). As shown in Figure 2-2, 84 percent of the city has been developed. The undeveloped area comprises 16 percent, which consists of parks and open spaces that are not anticipated to be developed; only 6 percent of the city is vacant land that is likely to be developed. Therefore, today's stormwater regulations will mostly be employed during redevelopment of existing properties. Originally, flood control and sedimentation were the primary issues, so strategies were employed to manage peak flows.

The construction of the regional detention facilities by 1984 remediated smaller storm event flows in some areas that had been developed before the establishment of regulations (as illustrated in the red - colored columns in Figure 2-2).

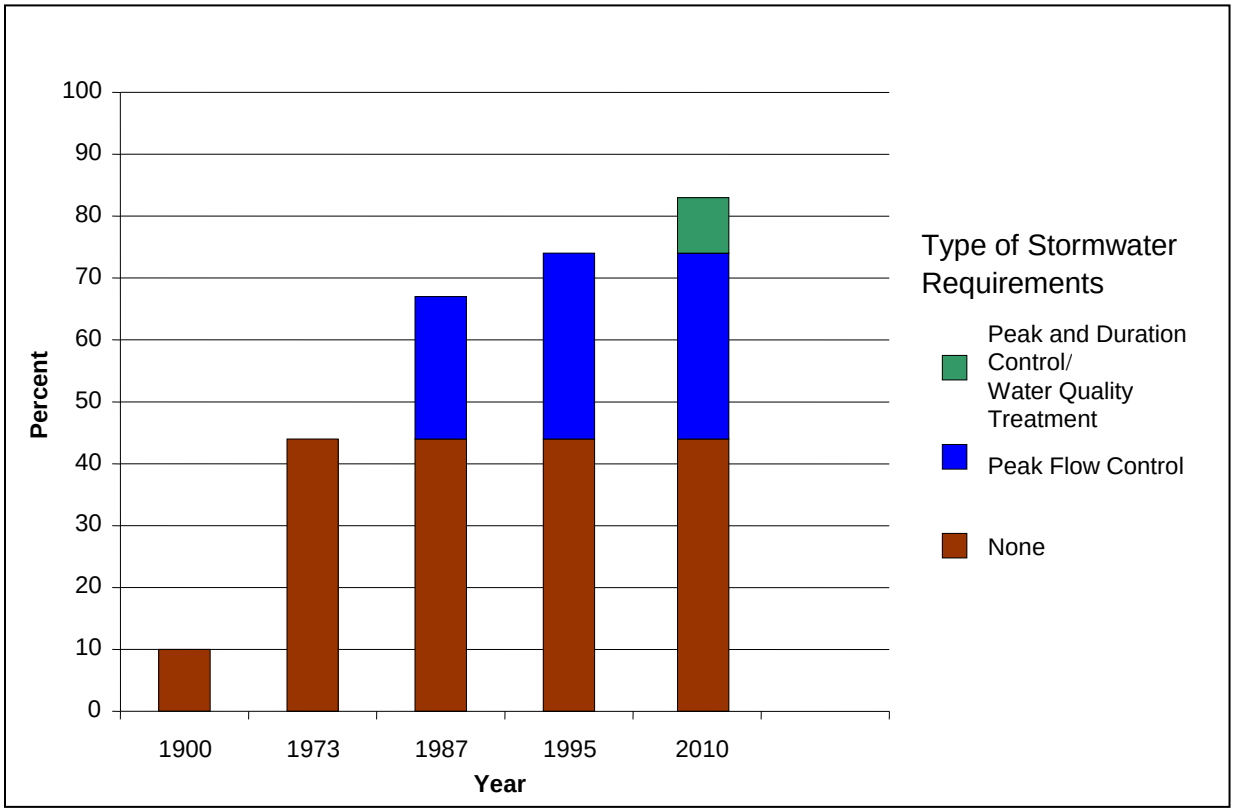

Figure 2-2. Percent of city developed vs. type of stormwater requirements.

Over time, it was recognized that efforts to manage flow *durations* were also needed to address runoff impacts on aquatic habitat. Water quality became a more central focus in the early 1980s and again in the early 1990s. When Puget Sound Chinook salmon were listed under the Endangered Species Act (ESA) in 1999, habitat received an even greater emphasis, leading to the development of procedures for regional road maintenance and stormwater management, as well as BMPs that comply with Section 4(d) of the ESA. Integrated on-site water systems that manage and more fully utilize groundwater, surface water, and wastewater are emerging as next-generation stormwater management techniques.

Advances in stormwater management have historically been driven by and/or supported by the citizens of Bellevue. In a recent budget survey, 9 out of 10 respondents agree that careful and balanced stewardship of our natural environmental resources will result in long-term improvement in the quality of life in Bellevue (City of Bellevue 2010 Performance Measures Survey, June 2010).

Current Challenges

A number of stormwater management challenges currently face Bellevue in the context of increased growth and environmental protection. The Washington State Growth Management Act (GMA) requires the City to encourage and accommodate growth and density while maintaining environmental protection—a task not easily achieved. As illustrated in Figure 2-2, much of the city was built prior to

modern stormwater standards. Bringing these areas up to the more protective standards would require extensive retrofitting, which is difficult and expensive in highly urban settings. While stormwater improvements will occur as redevelopment progresses, it will take decades to realize the resulting stormwater benefits.

As the field of stormwater management has evolved, approaches have migrated from end-of-pipe solutions to more holistic, programmatic approaches. This evolution challenges the Bellevue Utilities Department to merge the old systems with the new practices, from both systematic and programmatic standpoints. Examples of new approaches include restoration of ecological processes and basin management. For instance, rather than fixing specific habitat features, such as constructing pools in a stream reach where they are lacking, the preferred approach is restoring ecological processes that create and sustain habitat features. This approach requires addressing historical stormwater runoff and management actions that have concentrated or otherwise changed flows. Given that stormwater managers have limited influence over land use development and limited opportunities for stormwater restoration in highly urbanized areas, the new approaches pose significant implementation challenges. Today's basin management approach for stormwater maintenance activities means that stormwater is managed by land geography, rather than by roadways or grid systems. This approach often results in a more comprehensive view of basin-specific problems, with the understanding that solutions will vary according to basin-specific conditions (natural, constructed, and social). This approach allows for better targeting of problem areas, although it may not be as simple as the historical practices of following the roadways and maintaining any facilities that are encountered.

As was noted in the Nature of Stormwater section, much of the management of stormwater is outside the authority and control of the Storm and Surface Water Utility. Many of the pollutants entering the stormwater system are from non-point pollution, such as heavy metals from automotive brake linings, pesticides, or pet wastes. Some pollutants come from natural sources. Phosphorus (a nutrient that can increase algae growth in streams and lakes) and arsenic are found in soils in Bellevue and can leach into waters through streambank erosion. Some bacteria come from wildlife, such as geese or ducks. Current technologies offer only limited ability to remove pollutants once they have entered the system. Educational programs that focus on behavioral changes and source control methods are often the best tools to address these concerns.

As with any public agency, budgetary and staffing resources within the City of Bellevue and the Utilities Department are limited by fiscal resources, primarily stormwater utility rate revenue. Increasing demands and regulations typically come without commensurate funding, so adapting to new management needs can be challenging and often requires significant time to fully implement.

Future Challenges and Opportunities

Emerging stormwater management advances provide great opportunities for positive improvements for Bellevue's citizens and the environment, even as we face significant challenges.

Primary challenges include aging infrastructure, reduced forest cover, and global climate change. Global climate change represents the greatest amount of uncertainty and thus is the most difficult for which to plan. There is potential for changes in the intensity and timing of rain events, which could lead to increased winter flooding magnitude and frequency, summer drought, and changes to receiving water biology and chemistry (U.S. Global Research Program 2009; Water Environment Research Foundation 2009). Potential stormwater management modifications to address these issues include changes to 1) system maintenance requirements (need, frequency, and schedule), 2) design standards to provide adequate protection for changed conditions, and 3) regulatory and operational response to flooding and other storm-related emergencies. Global climate change could add complexity for meeting water

quality standards and recovering salmon populations, particularly if summers are warmer and drier, increasing water temperatures and changing the chemical balance in receiving waters.

Between 1974 and 1996 areas of high tree cover (>50 percent tree cover) decreased by 37 percent in the Puget Sound area (American Forests 1998). Bellevue tree canopy declined 20 percent between 1986 and 2006 (American Forests 2008). If this trend continues, it will create even greater stormwater management challenges because mature forests and tree canopy intercept and absorb stormwater runoff.

Constructed infrastructure will become more of a challenge as it ages, requiring more frequent maintenance and eventual replacement. The drainage system assets such as pipelines, catch basins, etc. are relatively new with an average estimated age of approximately 35 years as of 2010. Although most assets are in good condition, some assets such as corrugated metal steel pipelines are reaching the end of their useful lives and have been replaced or will need replacement in the near future. Additionally, even infrastructure that has years left on its design life can become functionally obsolete if it does not meet current or future capacity needs. The opportunities for positive improvements in the face of these challenges include new technologies and attitudes, as well as an updated Storm and Surface Water System Plan.

Low impact development (LID) is a stormwater management approach that preserves and restores natural hydrologic processes through appropriate site design, runoff control, and natural water quality treatment techniques. LID has the potential to reverse or minimize stormwater challenges through preservation and restoration of forests and vegetation for stormwater management, and treatment of stormwater closer to the source so that conventional infrastructure does not need to be upsized to meet higher capacity requirements. LID, however, has known limitations and is not appropriate for all sites. Many LID techniques rely on infiltration, which has the potential for unforeseen consequences as it is applied on a greater scale. Some of the concerns raised about LID techniques include the potential for increased landslides in unstable areas, basement or crawlspace flooding, migration of groundwater contaminants, increased maintenance costs, and the long-term viability of small, dispersed facilities, such as rain gardens.

A new class of pollutants has emerged as a potential threat to aquatic and human health over the last decade. Pharmaceuticals (usually from wastewater systems) and endocrine disrupters (found in some pesticides or other products applied to the landscape) are increasingly being detected in receiving water bodies. Effective pollutant removal technologies are not yet available. Even so, within the next decade, it is likely that stormwater managers will be implementing new best management practices to address these emerging concerns.

As knowledge about stormwater impacts increases and more is understood about runoff quality effects on aquatic and human health, there will likely be a call for new and stricter regulations, including stormwater effluent limitations and more restrictive water quality standards. Effluent limitations may spur treatment improvements; however, they may focus attention on individual parameters rather than more holistic approaches to stormwater problems.

Stormwater has been identified by the Puget Sound Partnership as a primary pressure impacting the health of Puget Sound. The Puget Sound Partnership is a community effort of citizens, governments, tribes, scientists, and businesses working together to restore and protect Puget Sound. The Puget Sound Partnership was tasked with creating an Action Agenda to clean up Puget Sound by 2020. The Legislature intends that all government entities within Puget Sound will exercise their existing authority to implement the applicable provisions of the Action Agenda (RCW 90.71.350). The major focal areas for the Action Agenda are land development, shoreline alteration, runoff from the built environment

(stormwater), wastewater, and loss of floodplain function. Efforts to reduce the impact of stormwater have already increased regulatory requirements. It is likely that additional changes to strengthen water quality standards, environmental guidelines, retrofit of existing facilities, and other processes will be made to reduce stormwater impacts.

New attitudes about sustainability are transforming views of stormwater as a resource, not a problem. Integrated on-site water management, such as LID, is an example of this paradigm shift to a more holistic approach. Another example is rainwater harvesting, where roof runoff is harvested for beneficial uses, rather than contributing to increased stormwater flows.

This Storm and Surface Water System Plan provides an opportunity to integrate these issues, provide recommendations to prepare for future challenges, and make a positive difference for flood control, water quality, and aquatic habitat in Bellevue.