Seattle Public Utilities

Crown Hill

Drainage & Sewer Plan

Final 12/13/24

Crown Hill Drainage & Sewer Plan

TECHNICAL MEMORANDUM

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Approved by: Leslie Webster (Dec 17, 2024 14:35 PST) 12/17/2024

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Executive Summary

Source: Crown Hill Urban Village Action Plan, OPCD

This plan for Crown Hill combines technical analysis and community input to catalog and prioritize the neighborhood's drainage and sewer problems. It charts a path forward that SPU, other City departments, developers, and neighbors can use going forward to fix the highest priority problems. It also includes strategies for aligning these infrastructure investments with broader community priorities like pedestrian safety, placemaking, and housing affordability.

Many parts of Crown Hill's drainage and sewer systems lack adequate capacity to carry water in large storms. This causes frequent street flooding and occasional sewer backups. the neighborhood also has many blocks without any drainage infrastructure, which creates problems for existing residents and businesses and makes redevelopment more difficult and expensive. Although similar capacity problems and conveyance gaps occur in many parts of Seattle, the issues in Crown Hill are uniquely challenging; because the urban village is located at the top of a hill that drains into four different basins, the usual policy and engineering questions present extra layers of complication.

The plan draws on a mix of recent community engagement and planning, internal SPU planning and engineering analysis, and coordination with other Seattle departments. Key findings and recommendations include:

- **Improving Crown Hill's infrastructure will depend on a mix of gray infrastructure and green stormwater infrastructure.** Gray infrastructure (pipes, detention tanks, curbs and gutters) is needed in some areas to convey and store concentrated flows from larger catchments. At the block scale, green stormwater infrastructure (GSI: rain gardens, bioretention, etc.) can provide water quality treatment, peak flow mitigation, and overall volume reduction.

- **A major challenge in Crown Hill is how to solve existing local capacity risks without creating or worsening downstream problems**; if a project moves water away from a flooding location more effectively, it can present risks of flooding or sewer backups elsewhere. While Stormwater Code will often offset the effects of individual building development, building out the drainage system in areas without existing conveyance also needs mitigation strategies like green stormwater infrastructure and/or detention systems.

- **Piped storm drains are not always the best option to solve conveyance gaps.** In many cases, a hybrid of piped storm drains, curb and gutter conveyance, and bioretention appears to be a better option when compared to a uniform storm drain approach. The planning process also explored the use of conveyance swales as another alternative, but found that this is generally not a viable option in denser mixed use neighborhoods like this one.

- **Improving the system will happen over time through a mix of near-term capital investments by SPU, "beyond code" partnership incentives, policy changes, and incremental improvements by developers, SDOT, and other parties.** Specifically, 17th Ave NW is the drainage backbone of north Crown Hill, and the system problems there are too significant and complex to wait for resolution through incremental improvements. Other areas have smaller problems that can be addressed over time through other mechanisms.

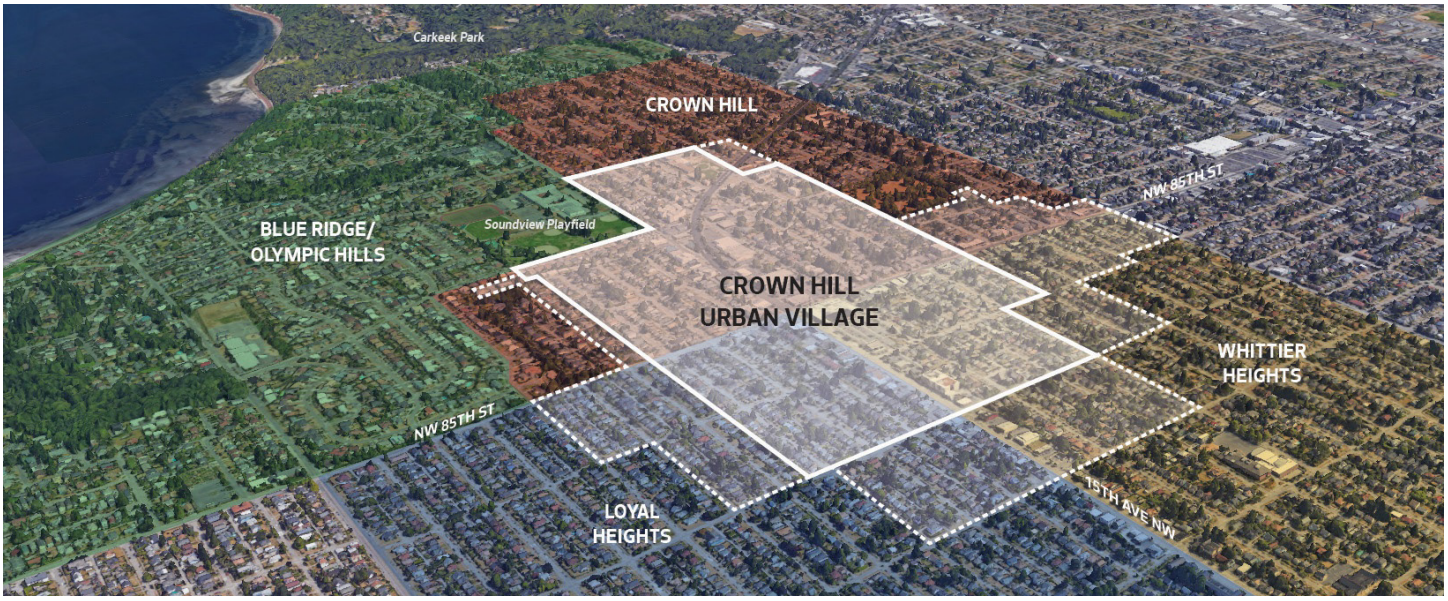

Figure 0.1 **Crown Hill aerial view.** *The dashed outline shows the new, expanded urban village boundaries as of 2019.*

Based on recent extensive community engagement, SPU identified several ways that our investments in stormwater management can align with priorities that the neighborhood has already identified. Most significantly, SPU Drainage and Wastewater (DWW) is planning capital improvements for 17th Ave NW to reduce flooding and sewer risks while enhancing the street for pedestrians and cyclists on this neighborhood greenway.

Crown Hill is a relatively low priority neighborhood in terms of racial and social equity investments. However, improving the infrastructure to accommodate growth here can decrease displacement pressure in higher equity priority areas. Also, alternative approaches to system layout may reduce the overall costs of expanded drainage, and alternative approaches infrastructure delivery (e.g., municipal latecomer agreements, local improvement districts, "beyond code" voluntary GSI partnerships) may help solve Crown Hill's system problems by having "growth pay for growth."

If cost-saving strategies tested in this neighborhood are successful, they could be a model for system improvements elsewhere. By using SPU funds for very targeted improvements, the approach could help free up funds to fill critical conveyance gaps and capacity problems in more places.

The plan concludes with a matrix of suggested projects, partnerships and policy actions to move the neighborhood's infrastructure forward while protecting the health of Seattle's receiving waters.


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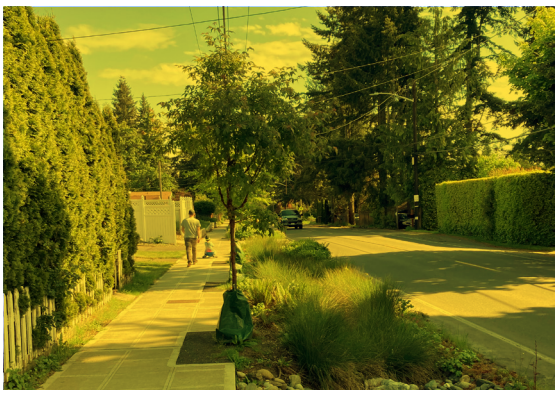
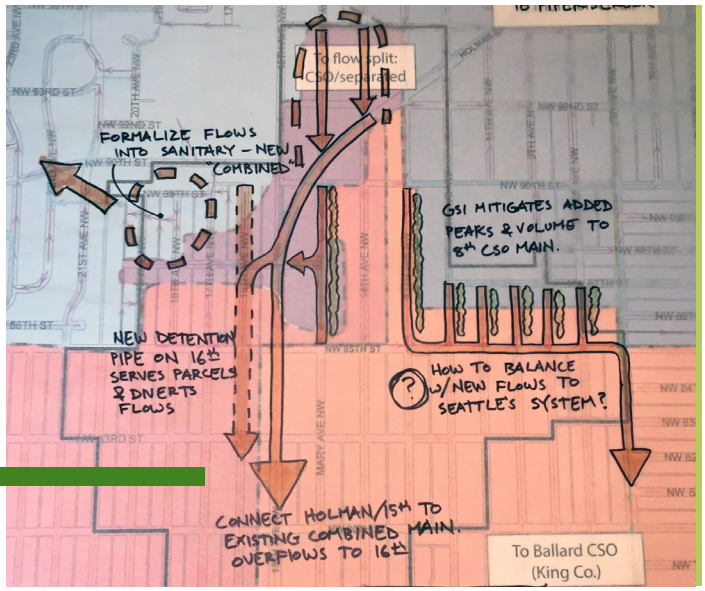



NW 89th St

1.0 Purpose and planning process



Source: SPU Crown Hill focus area planning Workshop #1.

1.1 Why an area drainage and sewer plan?

An area drainage and sewer plan evaluates infrastructure needs and opportunities at the neighborhood scale. It builds from this foundation to recommend a mix of capital investments, policies, and partnerships to effectively improve system function, reduce flooding and sewer risks, improve water quality, and meet local needs over time, aligning with broader community priorities wherever possible. Area drainage and sewer plans are most needed where a neighborhood has multiple significant, interconnected infrastructure problems and opportunities, and where anticipated changes are likely to raise questions about what to do with the system.

Upgrading infrastructure in developed, mixed-use neighborhoods is a complex undertaking. Drainage and sewer problems often overlap with other needed improvements, such as sidewalk gaps, transit needs, long-desired open space improvements, etc. Even where drainage and sewer challenges don't overlap with other needs, these infrastructure projects in built-out neighborhoods are almost always constrained by competing needs in the right-of-way, working with existing infrastructure upstream and downstream, and the challenge of minimizing impacts to existing residents and businesses.

It's rare that any one system improvement will solve complex neighborhood-scale system problems. The goal of area drainage and sewer plans is to lay out near-term and longer-term strategies for how different kinds of improvements can best combine for cost-effective resolution of risks in a specific area or neighborhood over time, setting a course for SPU investments, permitting decisions, and partnering priorities.

Key elements of an area drainage and sewer plan:

- **Neighborhood context.** What are the area's land uses, demographics, and equity considerations? What community goals emerged in previous planning efforts and through engagement for this project? What improvements, if any, are other departments and agencies prioritizing in the area? How do topography and soils influence options? See Sections 2.1-2.3.

- **Drainage and sewer systems and risks.** How does the system work, and what are the biggest challenges and opportunities in this area? Which areas are served by the combined system, which are separated, where does drainage currently go? How has development changed flows over time? See Section 2.4.

- **Long-term conveyance system recommendations.** How should a fully developed system be laid out? Where is infrastructure lacking, where are utility networks not connected? Are there any changes in flow direction that would decrease downstream risks? This should be aspirational – but also grounded in technical and regulatory reality. Which improvements are best achieved through code compliance of future development? Which could happen through near-term or future partnerships? Which upgrades are only likely to occur through SPU-led infrastructure projects? This should include some level of system layout for the study neighborhood – for Crown Hill, Section 3 presents a conceptual system layout, but in future plans more or less detail may be appropriate depending on the issues and available resources.

- **Recommendations for near-term investments.** Which near-term SPU investments will most help resolve acute system problems, align with upcoming investments by others, and set the stage for future incremental improvements? How can these investments fit with other community priorities? See Sections 3.5-3.6

- **Next steps: actions to support the plan's recommendations.** What additional work is needed to support implementation of the recommendations in this plan? Includes consideration of "inreach" to groups that implement development regulations, ideas for developing new policies and standards, and future partnering opportunities. See Section 4.

Crown Hill presents unusually complicated challenges to resolving these problems for two reasons: it sits at the intersection of four distinct drainage basins, each with its own technical and regulatory requirements, and it straddles the NW 85th St boundary between Seattle's piped drainage system (south of 85th) vs ditch-and-culvert drainage (north of 85th). While the system problems here have been recognized for at least 20 years, the need for clear direction has increased due to accelerating redevelopment.

1.2 Crown Hill planning process

The drainage and sewer planning process for Crown Hill included seven interrelated tasks that were completed during 2020-2023, each informing the others:

- **Neighborhood-scale technical analysis.** The project team studied Crown Hill broadly to understand the system, the problems, and the opportunities. This included flow monitoring, site visits, model calibration and improvements, review of Drainage System Analysis and Wastewater System Analysis results, GIS analysis, review of permit data, geotechnical analysis, and compiling information from past maintenance and investigations.

  ◊ ***Who?*** The Crown Hill project team, which includes a mix of planners and engineers from SPU's DWW Line of Business and Project Delivery & Engineering Branch (PDEB). This work was done with internal SPU resources as well as data from other City departments.

  ◊ ***Results*** : This analysis informed engagement with other stakeholders, findings and figures for Sections 2.4 and 3 of this planning document, and the scope for SPU's 17th Ave NW capital project.

Figure 1.2.A *SPU planners and engineers in an early Crown Hill analysis workshop.*

- **SPU subject matter experts "in-reach."** The project team convened workshops, presentations, and other discussions to get input from experts within SPU. This in-reach included a mix of technical review, planning priorities, and policy direction.

  ◊ ***Who?*** The project team together with subject matter experts across DWW and PDEB.

  ◊ ***Results:*** Direction-setting, identification of policy limitations and preferences for receiving basins, priorities for peak flow reduction strategies, findings and figures for Sections 2.4 and 3 of this planning document, and the scope for SPU's 17th Ave NW capital project.

- **Racial Equity Toolkit.** The project team held a Racial Equity Toolkit process to consider racial equity implications of the proposed work in Crown Hill.

  ◊ ***Who?*** The project team together with other SPU staff (DWW, Environmental Justice & Service Equity, PDEB), Seattle Department of Transportation (SDOT) and Office of Planning and Community Development (OPCD) staff with experience in public engagement for this neighborhood.

  ◊ ***Results:*** Better understanding of the racial and economic context of the neighborhoods, key stakeholder groups, and recommendations for the overall planning and implementation process. Key findings summarized in Section 2.3 of this plan.

Figure 1.2.B. *Office of Planning & Community Development hosts a community planning workshop (OPCD, 2019).*

- **Participation in outreach by other departments.**

OPCD and SDOT conducted a broadly-focused community planning effort in Crown Hill in 2019, leading to the Crown Hill Neighborhood Action Plan. SPU participated in in community workshops and reviewed OPCD plan documents to understand the neighborhood planning context.

◊ ***Who?*** OPCD, SDOT staff and the DWW planning lead.

◊ ***Results:*** Clearer awareness community priorities and neighborhood interest groups. Findings summarized in Section 2.2 informed the scope, alternatives, and outreach for SPU's 17th Ave NW capital project. OPCD incorporated information about SPU stormwater partnering incentives in the Crown Hill Neighborhood Design Guidelines.

- **Interdepartmental workshops.**

The project team held a series of workshops and smaller conversations to identify challenges and opportunities for coordinating infrastructure improvements over time.

◊ ***Who?*** The project team with representatives from SDOT (Street Use, Traffic Engineering, and Planning divisions) and OPCD.

◊ ***Results:*** Block-by-block consideration of potential conveyance, streetscape and GSI configurations, and street improvements. Clear direction for capital projects, identification of barriers to implementation through redevelopment, topics in need of clarification through Streets Illustrated update. Informed findings and figures for Sections 2.4 and 3 of this planning document, and the scope for SPU's 17th Ave NW capital project.

TYPES OF SYSTEM IMPROVEMENTS

Improvements to stormwater and sewer systems happen through a mix of approaches, including:

- **Capital projects.** Seattle Public Utilities (SPU) steps in where a significant investment is needed to fix a flooding, sewer, or water quality problem. These expensive, multi-year projects are often in the right-of-way, but can also happen on public or private parcels; they typically rely on design consultants and construction contractors. Projects can include a mix of gray infrastructure (like pipes and storage) and green stormwater infrastructure, or GSI (like conveyance swales and bioretention)
- **Smaller upgrades.** Various SPU programs provide spot fixes to drainage, sewer and water systems as needed to keep things working in a timely, cost-effective way.
- **Code-required improvements.** Some redevelopment projects trigger local infrastructure improvements. The City's code requirements and engineering standards are applied to make sure that projects have safe, adequate connections to the drainage and wastewater systems – this may include on-site detention or other mitigation, extending water or sewer services, and/or upsizing a storm drain.
- **GSI Parcel retrofits.** SPU programs like RainWise Rebates and Rain City Partnerships pay to have voluntary stormwater management facilities on private property, with the theory that many small installations spread out around a basin will reduce demand and improve system capacity.
- **Management of existing sites.** Side sewer maintenance, planting trees, raking leaves from catch basins, keeping fats/oils/grease and wipes out of sewers all contribute to system resilience.
- **"Beyond code" partnering.** SPU can pay development projects to provide GSI beyond their code-required improvements. See Section 3.5 for more detail.

- **Developer/property owner engagement.** After a review of likely redevelopment sites and current active permit activity, the DWW planning lead reached out to property owners and developers in Crown Hill to gauge potential for "beyond code" GSI improvements to reduce peak flows.
    - ***Who?*** The DWW planning lead for Crown Hill
    - ***Results:*** Identification of several potential "beyond code" partnerships, one of which moved forward through implementation, helping establish best practices for future partnerships. Clarity that the large redevelopment sites in the neighborhood don't have pending development plans that would alter SPU's capital project planning.
- **Flow reroute modeling.** Focusing on the complex, flood-prone basin at the center of the neighborhood, the project team modeled multiple combinations of flow re-routing, conveyance improvements, GSI partnerships and capital projects to reduce risks associated with peak flows.
    - ***Who?*** The project team, consultants
    - ***Results:*** Detailed, calibrated hydraulic model and analysis confirmed the need for a capital project and narrowed the scope of Options Analysis for that project. Refocused priorities for future engagement with community and stakeholders. Informed section 4.3 and the Options Analysis process for SPU's 17th Ave NW capital project.

In many cases, an area drainage and sewer plan should include a dedicated community engagement process to collect stakeholder input on problems, opportunities, and recommendations. For Crown Hill, the process included minimal standalone community engagement. First, this was because the City already has extensive community input from this neighborhood – recent planning by OPCD and SDOT recorded broader community priorities, and a long history of complaints and claims directly to SPU have documented concerns about drainage problems. Second, due to the complex engineering and regulatory context in this neighborhood (see Section 2.3), SPU wanted to develop a clear understanding of the system and possibilities before engaging with the public. Finally, SPU is following this planning process with a capital project to address stormwater and sewer problems on 17th Ave NW – Options Analysis for this project included public engagement to hear priorities on the upcoming City investments.

1.3 Planning themes

SPU's Shape Our Water planning process has established six citywide planning themes to help organize the interrelated system challenges that are addressed by stormwater and sewer planning. This table summarizes the planning themes and briefly how they connect to challenges in Crown Hill. Some of these themes will come up throughout this plan.

Table 1.3.1 **Shape Our Water planning themes, and their relevance to Crown Hill drainage and wastewater issues.**

Planning theme	Relevance to Crown Hill
System Development	The pace of redevelopment in Crown Hill is increasing. The area north of NW 85th St includes many blocks with partial or non-existent stormwater infrastructure. A key topic for this plan is to provide guidance for incremental system expansion and upgrades as redevelopment happens.
Too Much, Too Fast	Several of the acute system problems in Crown Hill are the result of too much stormwater hitting the system faster than existing pipes and ditches can handle. This can cause flooding and sewer backups. Unmanaged stormwater from Crown Hill also contributes to a variety of downstream problems. This plan will identify solutions to reduce the stormwater peak flow and volume while addressing other community priorities.
Pollution in Our Waters	The north half of Crown Hill sends untreated stormwater to Pipers Creek and directly to the Salish Sea. Long-term water quality treatment improvements for north Crown Hill can help treat stormwater that goes to Pipers Creek, and also directly to the Salish Sea (Puget Sound). (The southern half of Crown Hill drains to a combined sewer system, which conveys the stormwater and sewage to treatment at the West Point treatment plant.)
Creek and Shoreline Health	This theme is closely tied to "Pollution in Our Waters" and "Too Much, Too Fast." Parts of the neighborhood send untreated stormwater to Pipers Creek or directly to the Salish Sea. Investments in distributed water quality treatment would benefit those receiving waters.
System Stewardship	The flooding and sewer backup problems in Crown Hill frequently require SPU investigations and maintenance work. Improving system capacity will reduce the need for reactive work.
Shocks and Stresses	The existing capacity problems in Crown Hill are expected to worsen with climate change, with larger and more frequent flooding and sewer overflows. Similarly, existing vulnerabilities increase the likelihood of impacts from earthquake damage. Improving the stormwater and sewer system now and over time will make Crown Hill a more resilient neighborhood.

2.0 Crown Hill neighborhood context

Source: Crown Hill Urban Village Action Plan, OPCD

2.1 Land use

Crown Hill is a mixed-use neighborhood in northwest Seattle. Much of the neighborhood is characterized by lower density residential development, with a denser commercial and mixed-use spine running along 15th Ave NW and Holman Road. The neighborhood has a middle school, multiple parks, and a community center run by a not-for-profit community organization (Figure 2.1.A).

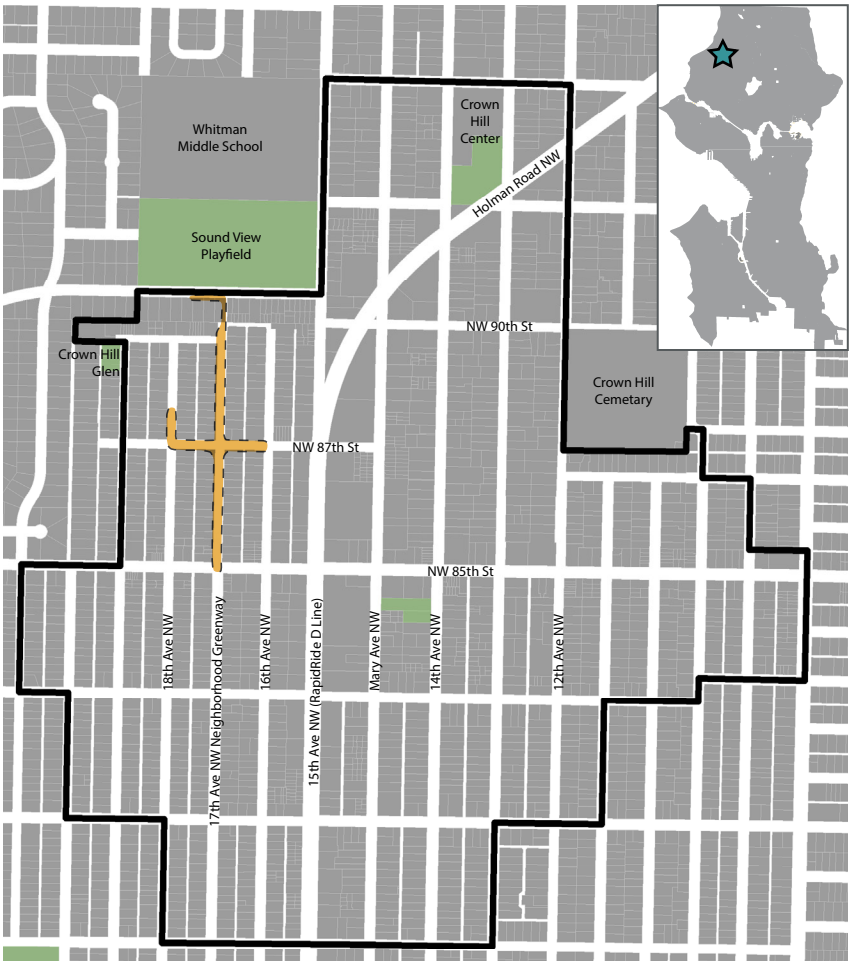


Figure 2.1.A. **Neighborhood context.** The Crown Hill urban village is outlined in black.

Following the boom in multifamily residential growth in nearby Ballard, this type of development is accelerating in Crown Hill. In spring 2019, the City expanded the urban village boundary and upzoned the neighborhood for denser development, expanding multifamily residential zoning and increasing the neighborhood's redevelopment capacity. The core of the neighborhood allows mixed commercial and residential uses up to 75' in height, stepping down gradually into lower density multifamily residential zones to the east and west (see current zoning in Figure 2.1.B).

The mixed-use areas along 15th Ave NW and Holman Road NW have many sites with opportunities for larger mixed-use redevelopment projects; that is, properties with much less existing development than the maximum allowed by zoning. However, the largest parcels in this area generally have long-term leases for the foreseeable future. Recent upzoning in the surrounding residential areas appears to be stimulating smaller-scale infill redevelopment there. Residential Small Lot (RSL) zoning allows development of 2+ housing units on lots that previously only allowed 1.

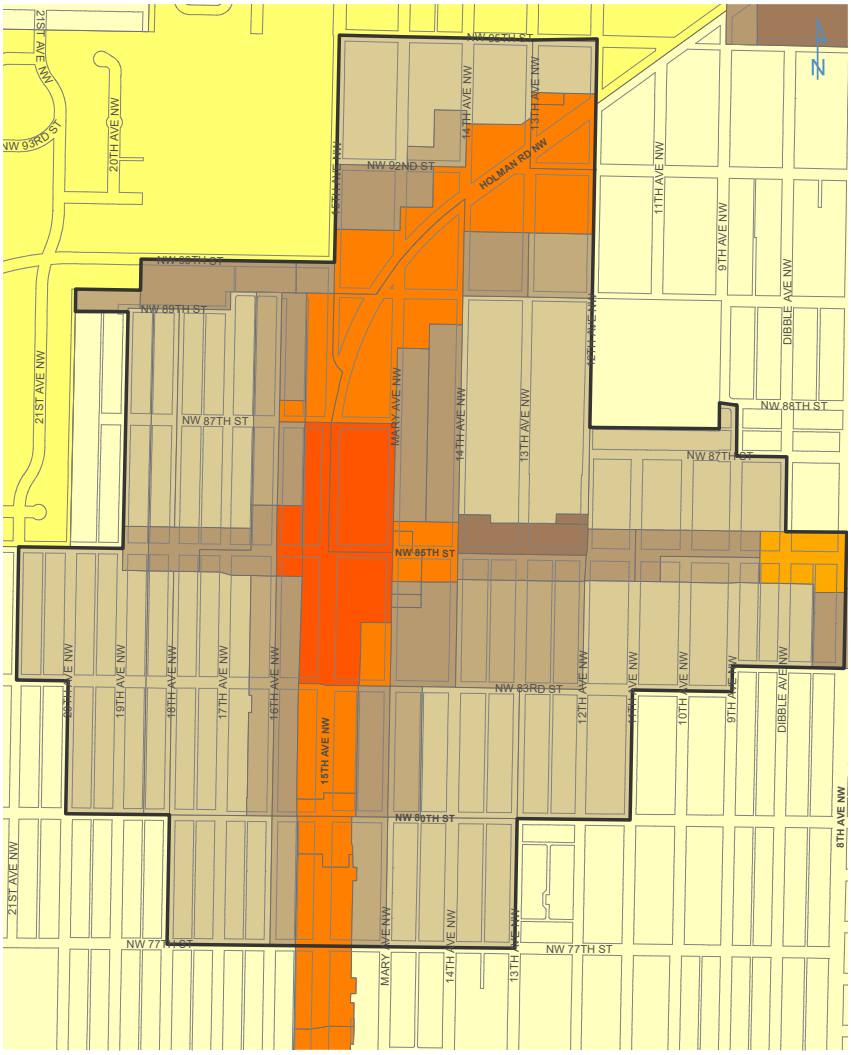


Figure 2.1.B **Crown Hill zoning.** *Mixed use zoning has its highest allowed density and height at NW 85th St and 15th Ave NW (max 75' height), tapering down to lower multifamily zoning to the east and west. This zoning represents the significant upzone that occurred in 2019.*

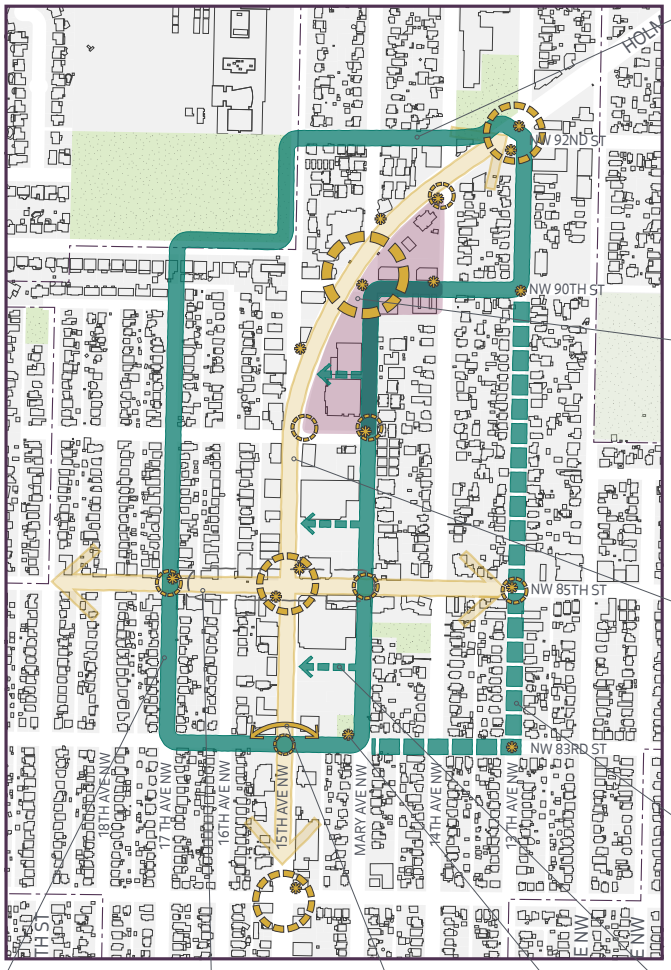
2.2 Community Goals

In 2018-2019, the Office of Planning and Community Development (OPCD) and Seattle Department of Transportation (SDOT) led a community planning process in Crown Hill. The final plan from this process is called the Crown Hill Urban Village Action Plan. This action plan identifies several priorities that emerged with potential relevance to drainage and sewer planning.

A recurring theme was a focus on continuous, safe pedestrian routes through and around the neighborhood, and traffic calming to discourage cut-through traffic off of 15th Ave NW. One specific concept that emerged was a pedestrian loop connecting key locations within the neighborhood as well as routes out to surrounding destinations (Figure 2.2.A).

Residents and businesses also prioritized the creation of a town center as part of redevelopment along the intersection of NW 90th St and Mary Ave NW. This area could become a pedestrian-oriented shopping district and public space over time, potentially including a pedestrian boulevard along the west side of Mary Ave with generous sidewalk areas, seating, and landscaping (Figure 2.2.B). This promenade concept presents an opportunity for SPU to partner with developers to incorporate stormwater features that will help decrease downstream flooding risks. See Section 3 for further discussion.

The community has also prioritized streetscape and open space improvements around 90th and Holman ("Holman Grove"), but street slopes in this area are not conducive to effective green stormwater infrastructure.



The Crown Hill Loop
Community members and City staff have been building on the idea of a Loop that links existing and future connections to neighborhood assets.

Gateways & Placemaking Corners
Enhance gateways and important corners with distinct architecture and public realm features such as open spaces, art, landscaping, and transit enhancements.

Holman Grove & Business District
Crown Hil neighbors painted a street mural on NW 90th, planted a community garden, and installed colorful planters and a curb bulb at NW 90th St & Mary Ave NW.

Future new development should be designed to foster a compact, walkable, and pedestrian-oriented neighborhood business district.

Improve the pedestrian experience on arterial roads
Enhance the pedestrian experience along Holman and 85th with pedestrian-oriented development and an enhanced public realm with art, open spaces, wide sidewalks, and landscaping buffers.

Walkable residential streets
Design and implement cost-effective walkways, traffic calming devices, and/or slow street designs that make residential streets comfortable for pedestrians & bikes.

Through-block Pedestrian Connections
As new development occurs, create pedestrian routes through long blocks to increase connectivity and walkability.

Enhancing the public realm with art & activation
Seek opportunities to collaborate with property owners and neighbors to implement small projects that enhance and activate the public realm with art, wayfindng, signs, landscaping, and events.

Reduce flooding on 17th Ave NW Greenway
SPU is evaluating options to reduce the frequency of flooding at this intersection, through a mix of improvements to 17th as well as managing stormwater upstream.

Spot improvements on NW 85th St.
Implement spot improvement projects on NW 85th St. to increase safety and enhance transit and traffic flows. (See page 24)

Pedestrian crossing at NW 83rd St.
A new pedestrian crossing is planned at NW 83rd St at 15th Ave NW, which is an integral piece of the Greenway on NW 83rd St.

Figure 2.2.A **Pedestrian Loop concept.** *From the Crown Hill Urban Village Action Plan document (OPCD, 2021). Priorities from the planning process align with DWW system needs. Redevelopment of a "town center" at NW 90th St and Mary Ave NW could help with stormwater demand management, and work on 17th could alleviate flooding and calm traffic.*

Figure 2.2.B **Mary Ave NW concept.** *Redevelopment along Mary could create a new "main street" one block east of high-traffic 15th Ave NW. Community supports narrowing the roadway to prioritize pedestrians and discourage cut-through traffic - extra space could be used for GSI, which would reduce pressure on downstream capacity problems (OPCD and SDOT, 2021).*

In addition to the Crown Hill Urban Village Action Plan, other past planning processes led by the City have identified and prioritized these specific corridors in Crown Hill as priorities for mobility improvements:

17th Ave NW Neighborhood Greenway:

17th Ave NW is designated by SDOT as a "neighborhood greenway" – a long-standing prioritized route providing safe pedestrian and bike connections. SDOT has invested in sidewalks and intersection safety improvements south of NW 85th Street and SPU added bioretention in the planting strip and curb bulbs as part of Ballard Natural Drainage Systems, but the segment from NW 85th St to Whitman Middle School is unimproved except for speed humps and intersection markings. In 2020, 17th Ave NW was closed to vehicular through traffic as one of Seattle's "Healthy Streets," prioritizing 17th as a bike and pedestrian route. Given that this street is also a priority area for solving Crown Hill's most frequent flooding problem, drainage infrastructure investments should reinforce greenway functions.

Figure 2.2.C *The 17th Ave NW Neighborhood Greenway is an important walking route for students to get to Whitman Middle School.*

Holman/15th Ave NW Bus Improvements:

This corridor is slated for improvements as part of SDOT's Route 44 corridor planning. These improvements are likely to focus on transit stop improvements, which offer few opportunities for green stormwater infrastructure along a busy arterial.

NW 92nd St Greenway:

NW 92nd Street, near the Crown Hill Community Center, has had some intersection improvements to build toward an east/west connection over to Greenwood, Aurora/Licton Springs, and Northgate. Here, SPU engaged with a recent development project to fund "Beyond Code" GSI for better drainage and to reinforce the greenway concept.

14th Ave NW:

The neighborhood applied for "Your Voice Your Choice" funding to provide traffic calming along the west edge of the Crown Hill Center and park. Narrowing the roadway may create an opportunity for adding a new conveyance swale and/or bioretention.

Figure 2.2.D **Example sidewalk/bioretention project.** *In addition to stormwater management, bioretention can improve the pedestrian environment and calm traffic (30th Ave NE Natural Drainage System).*

2.3 Demographics and equity considerations

On average, Crown Hill community has fewer renters, fewer people of color, and higher incomes than Seattle as a whole (Table 2.3.A). Consistent with these demographic statistics, Crown Hill falls mostly in the low priority tier of the City's Racial and Social Equity Prioritization Map (Figure 2.3.B). The Seattle 2035 Comprehensive Plan identified Crown Hill as having "High Access to Opportunity" (transit, educational attainment, services, jobs) and a relatively low displacement risk; as such, the neighborhood was identified as a priority for accepting future growth. Following this policy direction, the neighborhood was slated for a higher-than-average amount of new development through the Housing Affordability and Livability Agenda process (2019).

In early 2020, members of the SPU project team and colleagues from OPCD and SDOT conducted a Racial Equity Toolkit (RET) analysis for the planned 17th Ave NW capital project (Appendix A). The RET team reviewed these demographics, discussed findings from recent neighborhood engagement, and developed several recommendations going forward:

- For consistency with Comprehensive Plan policies, SPU should prioritize system improvements that facilitate growth, especially affordable housing, in this urban village. More development of all kinds in Crown Hill has potential to decrease redevelopment pressure on other Seattle neighborhoods with higher displacement risks.

- If SPU investments increase property values and/or make certain areas more developable, we should prioritize reaching out to affordable housing providers to share this information early.

- SPU should put additional effort into outreach to renters, youth, and people of color to make sure a diversity of voices influence the capital project outcomes.

	Crown Hill	Citywide
Renter Households	*36.5%*	*53%*
People under 18 years of age	*18.6%*	*15%*
People age 65 and over	*10.9%*	*11%*
Persons of color	*16.8%*	*33%*
Language other than English spoken at home	*12.4%*	*22%*
High school or higher	*96%*	*93%*
Bachelor's degree or higher	*54.9%*	*57%*
Median household income	*$76,401*	*$65,277*
Unemployed	*6.2%*	*7%*
Population below poverty level	*6.7%*	*14%*

Table 2.3.1 **Summary demographic stats.** *Data source: American Community Survey, summary source Department of Neighborhoods*

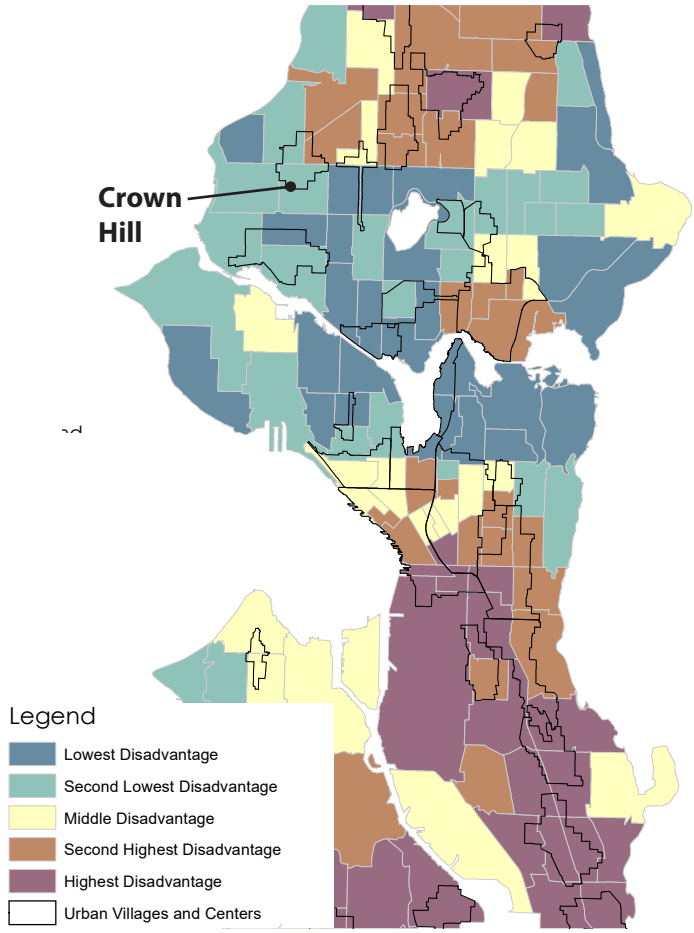


Figure 2.3.B **Racial and Social Equity Index Prioritization.** *The City's Racial and Social Equity Index evaluates relative disadvantage and priority for investments in more equitable outcomes. It's based on a composite of race and national origin, socioeconomic disadvantage, and health disadvantage. Crown Hill ranks mostly in the second lowest disadvantage/priority tier.*

Crown Hill is also a neighborhood that has had significant public engagement with the City over the past five years. We have detailed information about the neighborhood's priorities and concerns, especially through outreach by OPCD and SDOT. This led RET participants to recommend that:

- SPU should avoid repeating open-ended community visioning processes that recently took place. The Crown Hill Stormwater and Sewer Plan should build from the outcomes of previous community engagement to streamline the process and align SPU planning with community goals.

- The project team should do a thorough exploration of options for near-term SPU CIP investments before reaching out to the public. Because we already know many of the community priorities, it's important to find out first what's technically feasible, where it aligns with or conflicts with community goals, then reach out for engagement.

- SPU should build off existing City/community relationships with local organizations.

- If affordable housing providers start planning projects on blocks that will require storm drain extensions, SPU should explore potential to build the infrastructure as an SPU capital project supported by a municipal latecomer agreement (see Section 3.4 for further explanation). This approach may decrease cost to the affordable housing provider while helping to build out the stormwater system – this would need a careful review of statutory authority and legal considerations.

While Crown Hill generally has fewer socioeconomic disadvantages than Seattle as a whole, it's worth noting that some parts of the neighborhood north of NW 85th Street tend to have smaller lots, narrower streets, and less complete infrastructure than the southern part of the neighborhood. Anecdotally, there appears to be a higher incidence of seniors and lower income households within these areas, and they also tend to be the areas with the most significant drainage and sewer problems - as discussed in the next section.

2.4 Stormwater and sewer systems: challenges and opportunities

This section considers issues in the Crown Hill drainage and sewer systems, addressing connections to all six of the planning themes from Table 1.3.1. Most discussion focuses on "System development" and "Too much, too fast," but the others are covered toward the end of the section.

System development

Drainage infrastructure is developed to varying degrees in different parts of Seattle. Often, the stormwater systems are adequately matched to today's land uses: engineered, piped networks serve higher density areas with more impervious surfaces, and partial networks of ditches and culverts tend to serve lower density residential areas. Puddles and muddy street shoulders in lower density residential areas may be a nuisance, but are less of a public safety risk than flooding.

Other areas like Crown Hill present a mismatch between land use intensity and drainage infrastructure, where increasing growth happens on blocks with inadequate stormwater infrastructure; as a neighborhood grows and become more impervious, underlying capacity problems worsen and present greater risks to residents and businesses. Depending on whether drainage is going to separated or combined systems, increased stormwater volumes can translate to frequent flooding, sewer overflows into the street, or even sewer backups into homes and businesses.

Most of Seattle's stormwater and sewer infrastructure north of 85th Street was built when the area was still part of unincorporated King County. At that time, the County didn't typically require development to provide piped storm drains or sidewalks, so many of those blocks still rely on a series of ditches and culverts, typically undersized relative to present-day engineering standards and runoff volumes. Ever since the City annexed these areas, it's been an ongoing struggle to meet the demands of a more urban context.

Crown Hill straddles the dividing line in Seattle's stormwater and sewer systems. South of NW 85th Street, a piped combined sewer system collects stormwater runoff from every parcel and street and drains it south to Ballard and the new Ship Canal storage tunnel. North of NW 85th, blocks have a patchy mix of stormwater assets including storm drains, detention pipes, ditches and culverts, or nothing at all. In some cases, shallow culverts flow into deeper engineered storm drains or vice versa (Figure 2.4.A).

Further complicating system planning in this neighborhood, Crown Hill is also at the intersection of four distinct drainage basins, each with their own flow paths, system challenges, and stormwater management requirements. In the middle of those basins is a subbasin that splits into the NW and SW basins. See Figure 2.4.B and Table 2.4.1.

Overflowing ditch and street ponding *at the intersection of 17th Ave NW and NW 87th Street.*

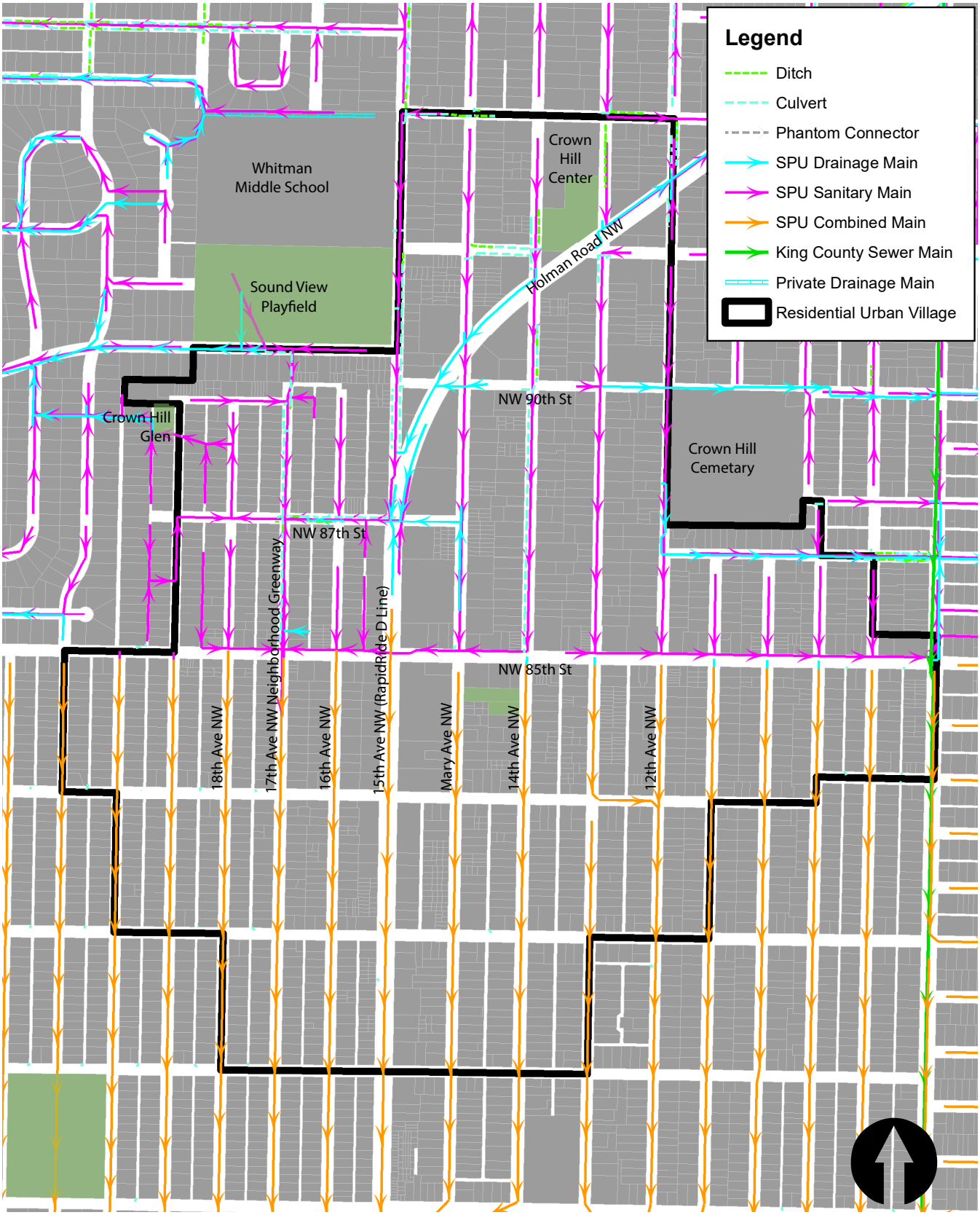


Figure 2.4.A **Existing stormwater and sewer infrastructure.** *Crown Hill straddles the dividing line between Seattle's formalized combined sewer system south of NW 85th St and its informal separated system north of NW 85th St. This division also tracks with sidewalks; south of NW 85th Street, every block has sidewalks. North of NW 85th Street, only a small fraction of blocks have them.*

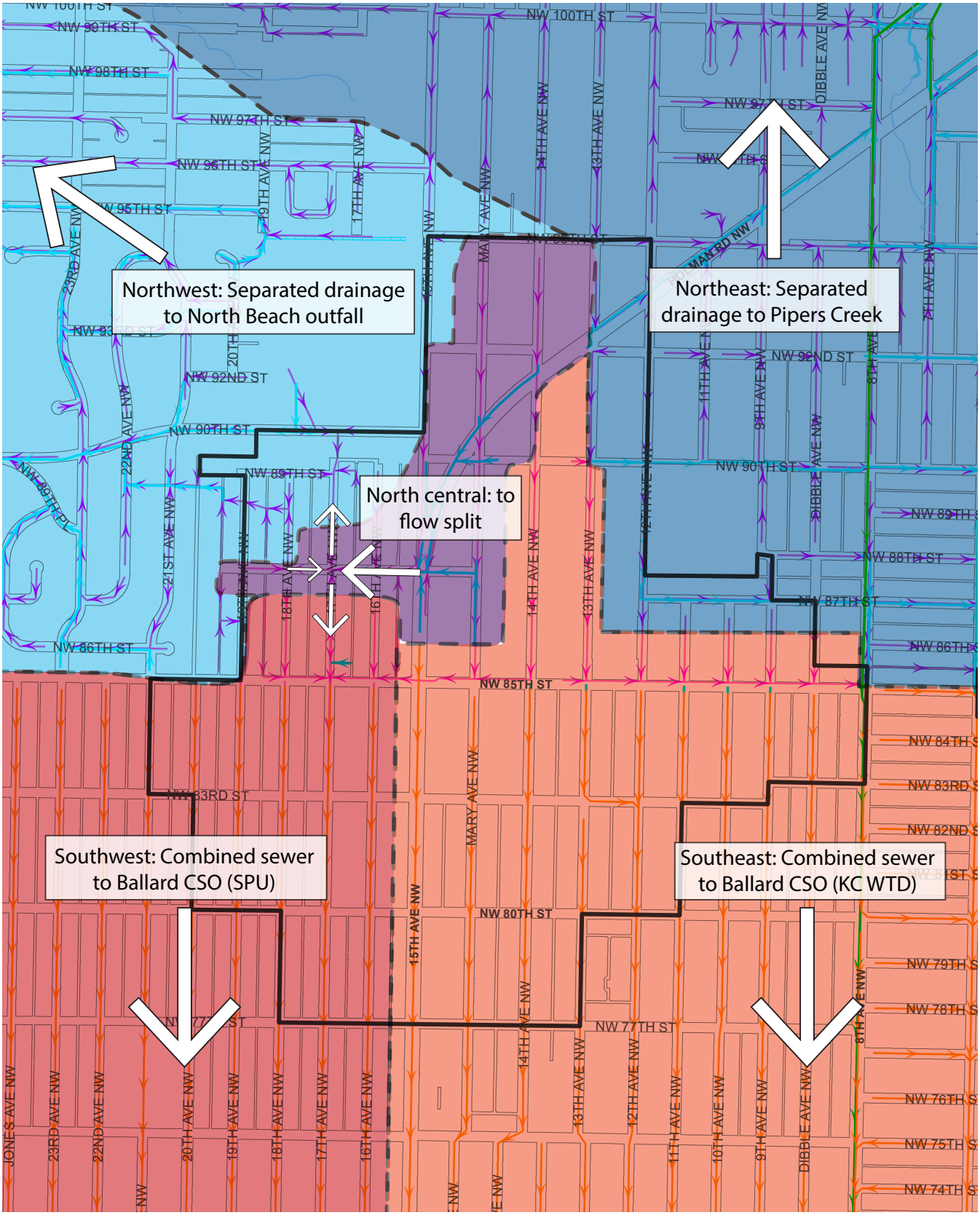


Figure 2.4.B **Stormwater drainage basins.** *Crown Hill sits at the intersection of four receiving basins. The purple area in the middle is the epicenter of drainage/wastewater risks in this neighborhood. It drains both south and north through an informal flow split at 17th Ave NW and NW 87th St.*

Table 2.4.1 **Crown Hill stormwater drainage basins (see Figure 2.4.B)**

Basin Location	Conveyance Type	Receiving Water	Stormwater Mgmt. Priorities*	Notes
Northwest	Minimal stormwater infrastructure within this part of Crown Hill urban village	Salish Sea (North Beach outfall)	Water quality; flow control to reduce localized flooding	The portion of this basin within the urban village is mostly in a depression that drains to parcels and an alley, with some drainage infiltrating into a sanitary sewer.
Northeast	Mix of piped storm drains and gaps	Pipers Creek	Flow control and water quality for creek protection	No known localized flooding challenges within the urban village, some capacity risks downstream in the basin. Private development in creek basins like this area must meet the highest level of flow control and water quality mitigation.
Southwest	Piped combined sewers (sewer and drainage)	West Point sewer treatment plant, via SPU combined sewer system	Flow control for local sewer capacity	While the Ship Canal Water Quality Project is expected to minimize combined sewer overflows in this basin for the coming decades, flow control is still important to preserve local sewer capacity through south Crown Hill and Ballard. As an added benefit, reducing volume and peak flow from this basin will preserve capacity and save energy for the storage tunnel and treatment plant.
Southeast	Piped combined sewers (sewer and drainage)	West Point sewer treatment plant, via King Co. combined sewer trunk lines	Flow control for local sewer capacity	(Same notes as SW quadrant) Additionally, any system changes that reroute routing new flows to this basin may require revising the Seattle/King County Joint Project Agreement and Wastewater Contract, both approved by Seattle City Council and King County Council.
North central	Mixed: some blocks lack drainage, others have ditch & culvert or piped storm drains. Some detention pipes.	An ad-hoc flow split at 17th Ave NW & NW 87th St sends flow north to the Salish Sea and south to the combined sewer.	Water quality, and flow control to reduce localized flooding and improve/preserve local sewer capacity	These approximately 30 acres contribute to the biggest cluster of flooding and sewer capacity problems in Crown Hill. Because of the flow split, stormwater management priorities from both the Northwest basin and Southwest basin apply.

**North of 85th, conveyance gaps are an ongoing challenge for redevelopment and City projects in the NW, NE, and north central basins. One goal of this area drainage and sewer plan is to provide guidance for reviewing future projects within these system gaps. Per Stormwater Code, any system extensions must meet an "Ensure Sufficient Capacity" requirement to demonstrate that they won't increase downstream risks -- this is true for any of the basins described here.*

North of NW 85th St, many blocks in Crown Hill either don't have any stormwater conveyance or have inadequately sized infrastructure. Accelerating redevelopment is increasing questions about how to tie new buildings into the existing stormwater system in those areas with no existing drainage, or with undersized infrastructure. See Figure 2.4.C for an illustration of how many parcels lack adequate existing stormwater infrastructure to tie into.

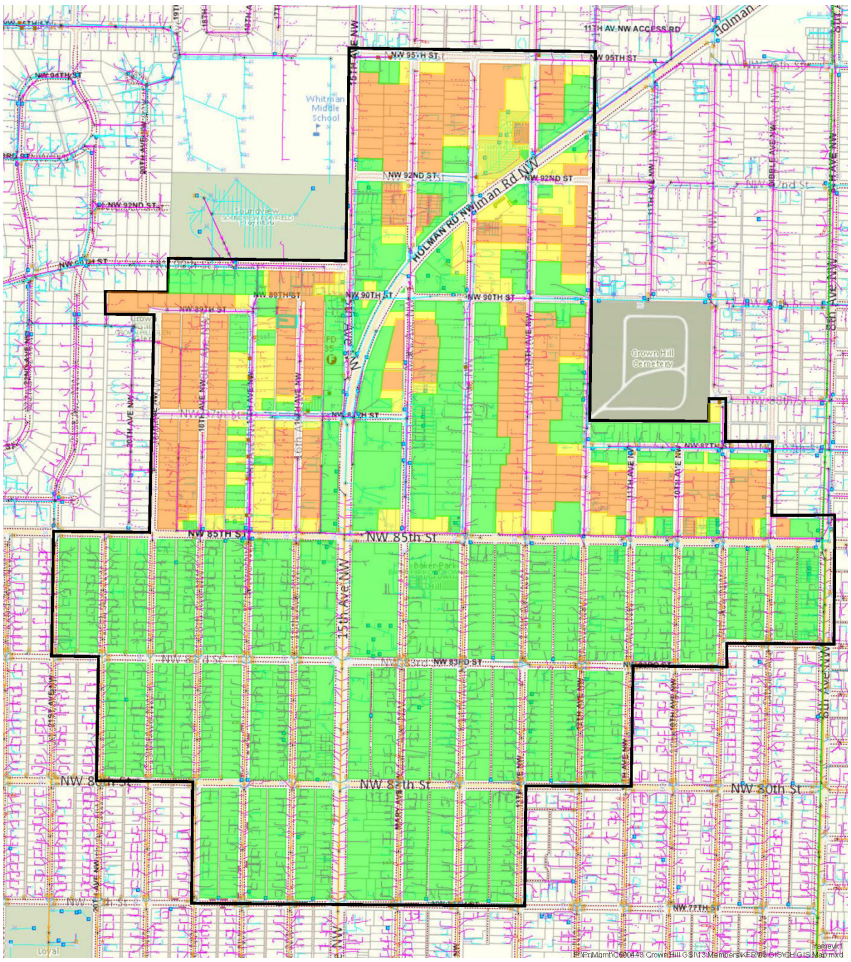
If a proposed project with more than 5,000 sq ft new and replaced impervious surfaces doesn't abut an existing storm drain, the City typically requires that project to build a storm drain extension. In practice, these extensions are mostly required if development is within 600' of an existing main. At an estimated rate of $1,000 per linear foot for piped conveyance, this could potentially discourage development in some areas within the urban village. While projects that are further than 600' from an existing main often get exceptions from this requirement, the system gap adds time, complexity, and uncertainty to redevelopment.

The City also has an "Ensure Sufficient Capacity" requirement for SPU and SDOT's capital projects; this policy requires projects to evaluate and mitigate their impacts to downstream receiving systems. Implementation of this policy is complicated and time-intensive. More work and staffing is needed to establish best practices for applying "Ensure Sufficienct Capacity" consistently and effectively.

Blocks that lack adequate infrastructure present complex permitting challenges for project engineers and permit reviewers (SDCI Drainage Review and SPU's Development Services Office), who must make determinations not just about whether drainage extensions are required, but also about which basin the project should drain to and whether improvements are needed in the downstream conveyance system.

In terms of the impacts of development on the existing drainage and sewer systems, development has mixed effects. On one hand, where older development already drained to the City's system, redevelopment tends to improve conditions since the new projects are often required to meet Stormwater Code requirements, holding back water that previously went into the system with no mitigation. In cases where older development lacked formal drainage, runoff may be entering the system more directly and exacerbating existing problems.

See Section 3 for further discussion and recommendations about conveyance system gaps.



Conveyance Ratings

- Piped conveyance w/ inlets
  Ditches in good condition
  Culverts w/ inlets or periodic ditches
  Short segments of curb and gutter
- Ditches and culverts in poor condition
  One or two parcels upstream of PSD/ditch/culvert
  Long segments of curb and gutter
- No formal stormwater conveyance
  Long segments of informal gutter flow

Figure 2.4.C **Drainage conveyance gaps.** *The drainage system in Crown Hill is patchy. South of NW 85th St., all parcels have access to storm drains. North of 85th, some parcels have storm drains, others ditches and culverts, and many no drainage system at all.*

Too much, too fast

Figure 2.4.D labels capacity risks in the neighborhood. Those risks include reported and observed flooding complaints, sewer backup claims, and modeled sewer capacity risks from SPU's Wastewater System Analysis and Drainage System Analysis: Capacity Evaluation & Prioritization.

Problem A: Street flooding on 17th Ave NW

Near the center of the Crown Hill Urban Village, a highly impervious catchment drains to the intersection of NW 87th St and 17th Ave NW. This intersection is the most visible, impactful stormwater and wastewater system problem in Crown Hill (Figure 2.4.D , Problem A).

The contributing area includes approximately 30 acres, which drain westward to a tee in the storm drain system, located at NW 87th St and 17th Ave NW. A drainage structure acts as a flow splitter to route roughly half the flows to the separated system to the north (North Beach outfall), and the other half to the south into the Ballard combined system. Twelve-inch culverts flowing to the north and the south are both relatively flat and undersized for peak flows, resulting in upwelling from inlets, overtopping ditches, and street flooding (Figure 2.4.E). SPU investigations have documented significant ponding in the street for several hours after heavy rains.

Frequent blockages occur at the flow splitter; SPU crews repaired a collapsed ditch just south of NW 87th Street in 2019. While clearing this blockage helped, street flooding still occurs because the ditch-and-culvert system simply lacks the capacity to handle the incoming flow.

A major inconvenience to adjacent residents, this flooding is also a barrier and a safety hazard to pedestrians, bicyclists, and drivers on NW 87th Street and 17th Ave NW. 17th is designated as a neighborhood greenway and a "Stay Healthy Street," serving as the primary north/south bike and pedestrian connection through the neighborhood, and pedestrian connection to and from Whitman Middle School.

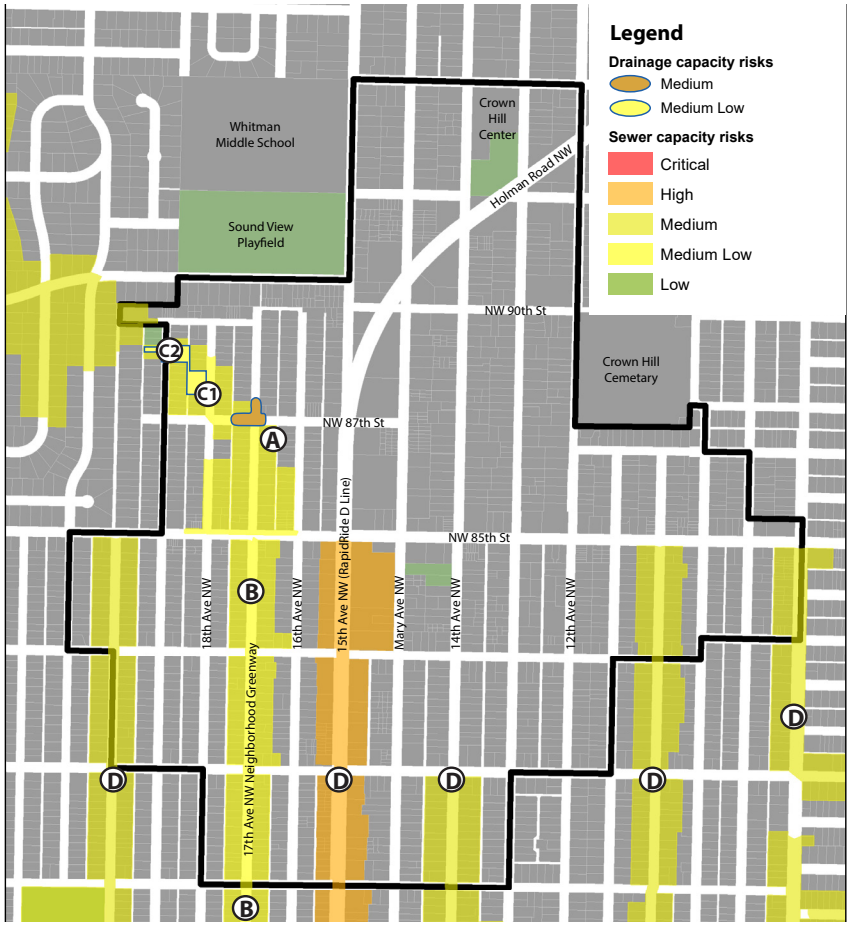


Figure 2.4.D **Observed and modeled drainage and wastewater capacity problems.** *While the north half of Crown Hill has many blocks with missing or undersized stormwater infrastructure, some subareas have more acute capacity problems. These have been identified through observations, modeling, or both. See text for explanation of problem areas A-D.*

Modeling and observations suggest that major street flooding occurs anytime 2 inches of rain or more fall in a 24-hour period (i.e., the "2-year design storm"). Further, because of deficiencies in the drainage assets, sedimentation regularly clogs parts of this system and cause even worse performance than the model suggests. Nearby residents describe flooding over the roadway several times every winter.

Problem B: Sewer backups on the 17th Ave NW combined sewer

Farther south on 17th Ave NW, two clusters of sewer backups and sanitary sewer overflows occur between NW 75th St and NW 85rd St (Figure 2.4.D, Problem B).

Modeling through the Wastewater System Analysis simulated excessive surcharging when 1.4 inches of rain or more fall in a 24 hour period (i.e., the "1-year design storm "). This performance falls below SPU's performance targets, and it means that these blocks are at an elevated risk of sewer backups. It also indicates system performance below the minimum threshold in DWW's Interim Conveyance Design Criteria. More detailed local modeling analysis focused on this area confirmed that in the 5-year storm, the modeled peak hydraulic grade line is above the ground

Figure 2.4.E *Street flooding across NW 87th St. at 17th Ave NW (Area A on Figure 2.4.D). Upwelling from a drainage inlet is visible behind the white truck; this phenonomenon happens multiple times each year.*

surface along most of 17th Ave NW between NW 85th St and NW 90th St. In addition to the modeling findings, claims data indicate a capacity problem in this combined sewer main.

On September 2, 2014, a large storm hit this area. Rain gauges showed 10-minute duration peak flows between the 2-year and 10-year historic storms (although a small cloudburst may have moved through Crown Hill with more intense precipitation than what the rain gauges captured). The storm led to numerous sewer backups on 17th Ave NW, with at least 13 homeowners filing claims and SPU paying for damages in at least 8 instances. In claim documents, several homeowners refer to previous sewer backups in their basements, indicating that this is a recurring problem.

Because Problem B is hydraulically connected to Problem A, managing stormwater flows to reduce flooding at NW 87th St (Problem A) needs to avoid making downstream sewer capacity problems on 17th Ave (Problem B) any worse; simply moving the stormwater out of Area A faster could increase backups downstream in Area B or cause new flooding or back up issues.

Problem C1: Street & parcel flooding in northwest Crown Hill

Farther to the west, DWW's Drainage System Analysis System Layout Challenges technical memo identified a large "closed contour" enclosing about a dozen private lots in a depression with no ditches, culverts, or storm drains (Figure 2.4.D, Problem C1). Surface flows from a tributary area of approximately 5 acres flow to backyards and an alley between 18th Ave NW and 19th Ave NW. The alley is unimproved and unpaved, but is used by adjacent properties. Ponding in the alley itself enters the sewer line through pick holes in the maintenance hole lid – this de facto drainage solution mitigates the ponding, but is inconsistent with permitted use of that sewer pipe.

In addition to ponding in the alley, residents report that standing water on 18th and 19th Aves NW runs through side yards to get to the low points in the interior of the block, sometimes flooding homes in the process. Based on field observations and anecdotal reports from neighbors, private improvements have decreased this problem on the 19th Ave NW side, but have been unable to manage the flood volumes coming off 18th in spite of significant effort by homeowners. A major contributing factor to this flood volume is runoff that flows north from NW 87th St. Redirecting that water to stormwater infrastructure on 17th should reduce street and parcel flooding.

A 2022 DWW drainage investigation of past claims, photos, and videos of flooding categorized the risk assessment of these flooding problem as "A (Highest)," and found that flooding of private property and structures has occurred multiple times during events smaller than the 6 month storm.

Problem C2: Sewer capacity risk and access challenges

In northwest Crown Hill, a sewer main runs through easements under multiple private properties and Crown Hill Glen, a park property (Figure 2.3.D, Area C2). This trunk line drains approximately 100 acres of Crown Hill (see Figure 2.4.F). Although the Wastewater System Analysis identified a modeled capacity risk at this line and the area immediately downstream, past claims in this area appear to have been focused on stormwater flooding rather than sewer backups. If capacity problems develop or the pipe fails in one of these easement parcels, it could be highly disruptive to residents and businesses in Crown Hill.

Problem D: Multiple sewer capacity risk areas flowing south

Modeling through the Wastewater System Analysis identified multiple capacity risks in the sewer mains flowing south and northwest from Crown Hill (Figure 2.3.D, Area D). 20th Ave NW, 17th Ave NW, 15th Ave NW, 14th Ave NW, 11th Ave NW, 10th Ave NW, and 8th Ave NW all have some degree of modeled sewer capacity risk.

Based on an assessment of likelihood, consequence, and equity considerations, most of the modeled north/south sewer capacity risks range from "low" to "medium." 15th Ave NW is the only Crown Hill street with a sewer risk area classified as high risk, based on 15th Ave's role as the major arterial through this area and its concentration of higher density development.

It's worth noting that out of these modeled risk areas, 17th Ave NW is the only street with a concentration of sewer backup claims. It may have only ranked "medium low" because the Wastewater System Analysis modeling didn't capture the full extent of the drainage catchment entering the combined sewer on 17th. See Section 3.4 for strategies to address the system challenges identified in this section. These modeled sewer risks should be considered in the context of citywide modeling - there are hundreds of modeled sewer risks and these are relatively low risk/low priority. The City should look for opportunities to fix them before they become worse, but they don't rank with some of the observed problems in Crown Hill.

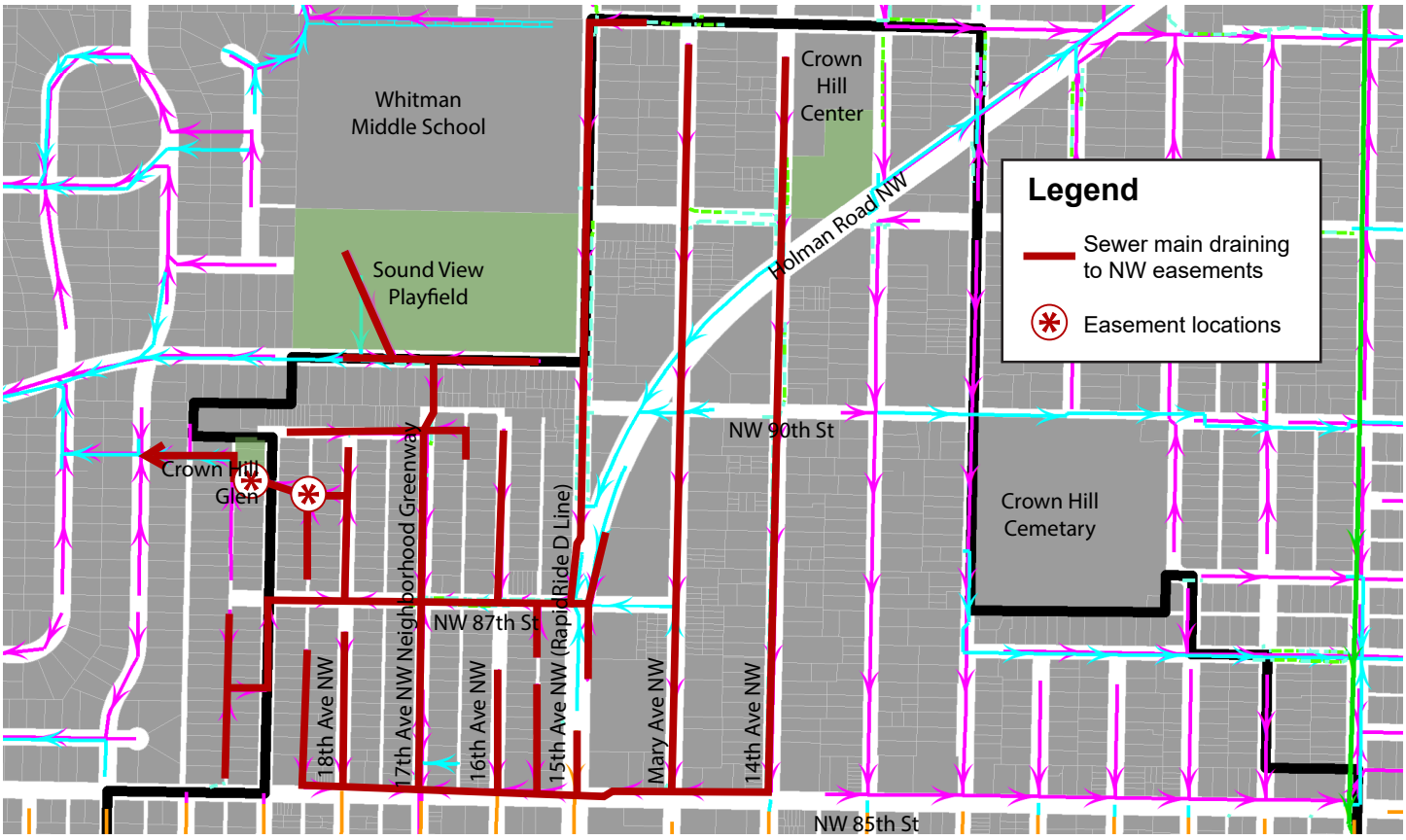


Figure 2.4.F **Easement sewer catchment.** *The northwest quadrant of Crown Hill drains west through easements on private and public property. This area has been identified through modeling as a capacity risk area (Figure 2.4.D, area C2), and while no acute current problems are known, pipe failure in these easements would be highly disruptive to the Crown Hill neighborhood.*

Pollution in Our Waters + Creek & Shoreline Health

More than half of Crown Hill drains to the combined sewer system. Since stormwater from these areas is managed through sewage treatment, and the combined sewer overflow risks will be remedied by the Ship Canal Water Quality Project, there are no major water quality or aquatic health issues to speak of in Crown Hill south of NW 85th St.

In the smaller portions of Crown Hill that drain to Pipers Creek and direct discharge to the Salish Sea, future capital projects and partnerships should find opportunities to improve water quality through the use of GSI and other BMPs where feasible. Treating runoff from roads and parking lots should be the top priority.

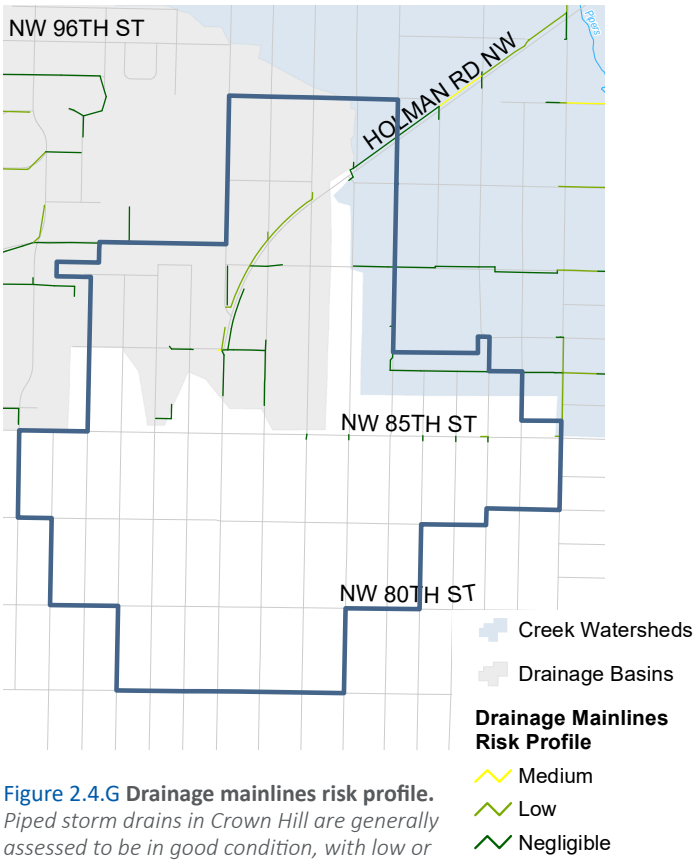


Figure 2.4.G **Drainage mainlines risk profile.** *Piped storm drains in Crown Hill are generally assessed to be in good condition, with low or negligible risk of failure (Drainage Mainline Risk Profile maps, SPU 2022).*

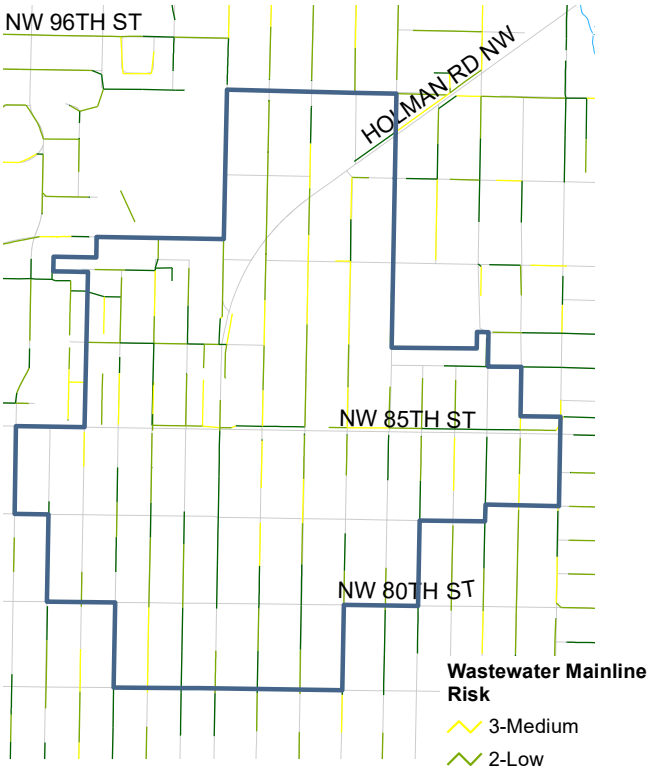


Figure 2.4.H **Sewer mainline risk profile.** *Sewer mains in Crown Hill range from negligible to medium risk, based on age and condition. This mix of conditions is typical of the sewer system throughout Seattle. SPU's Sewer Rehab program assess and improves sewer pipes on a continuous basis (WWSA).*

System Stewardship

SPU has city-wide assessments of asset condition for most types of stormwater and sewer infrastructure. Findings for the Crown Hill area can be summarized as follows:

- Storm drains, where present, generally have negligible or low risk within the Crown Hill urban village. No major problems identified based on asset condition (Figure 2.4.G).

- Sewer pipes are more variable, with about a third of assessed pipe falling in the medium risk category (the rest are “low” or “negligible”). See Figure 2.4.H.

Maintenance work orders have a relatively high concentration in the area around 17th Ave NW and NW 87th street (Figure 2.4.I), presumably due to the previously discussed capacity problems in this part of the ditch-and-culvert system. Even when fully functioning, the existing system tends to overtop into the street during rain events. And due to the heavy volumes managed and flat pipes in this area, sedimentation is heavy and causes frequent clogging, exacerbating the capacity problems.

Shocks and Stresses

According to the Shape Our Water Seismic Risk Assessment, both sewer and drainage seismic risks are low within the Crown Hill urban village.

Climate change is causing larger and more frequent storms, which will tend to worsen the existing problems described in the “Too Much, Too Fast” section above.

Overall, any projects to address the existing capacity risks and access challenges in Crown Hill have the potential to increase system resilience by adding both capacity and redundancy.

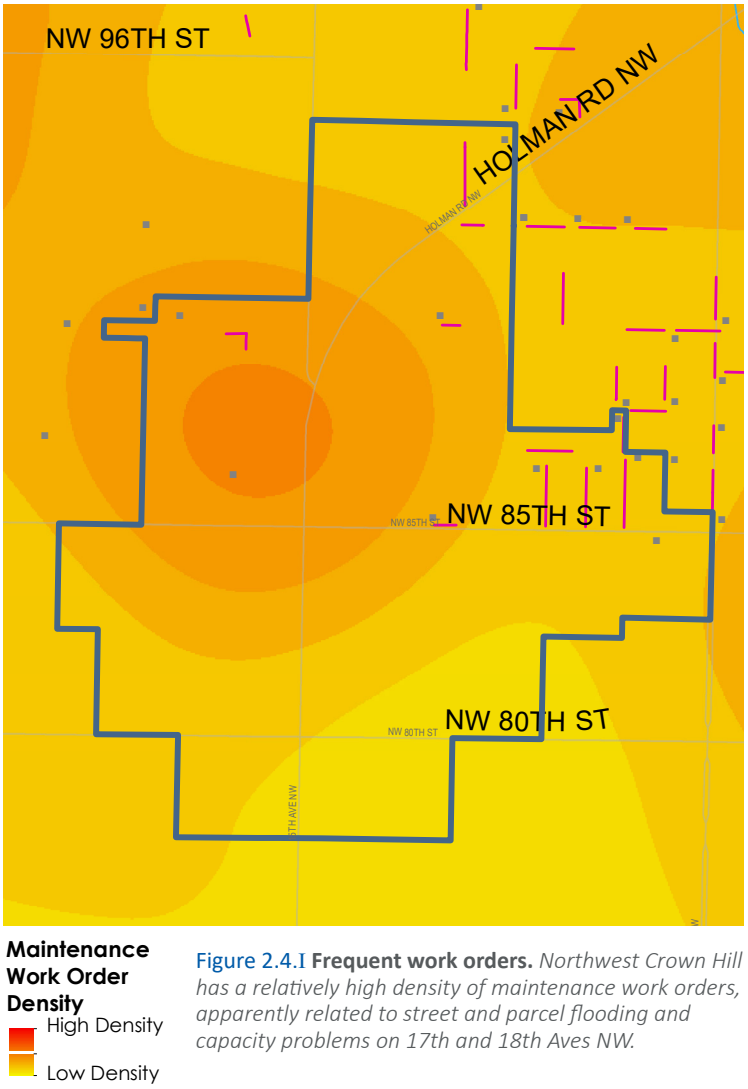


Figure 2.4.I **Frequent work orders.** *Northwest Crown Hill has a relatively high density of maintenance work orders, apparently related to street and parcel flooding and capacity problems on 17th and 18th Aves NW.*

2.5 Topography and soils

Slopes and soil type inform the design of conveyance improvements and stormwater management strategies.

From Crown Hill Center and Park, the neighborhood gently slopes away in all directions (Figure 2.5.A). The northwest corner of the urban village has a large depression (i.e. “closed contour”, Figure 2.4.D, Area C).

Soils in Crown Hill are mostly advance outwash deposits or subglacial till. Outwash tends to allow shallow infiltration, while till is highly variable and site-specific. A lobe of the higher-infiltration outwash extends down from the north into the acute flooding area (Area A) (Figure 2.5.B). The neighborhood has few known contaminated sites or leaking storage tanks.

Through site-specific geotechnical analysis including PIT tests and deep infiltration wells, SPU found high potential for shallow infiltration along 17th Ave NW, and for deep infiltration through underground injection control wells (UICs) at specific locations along 17th Ave NW and NW 90th St (Figure 2.5.B).

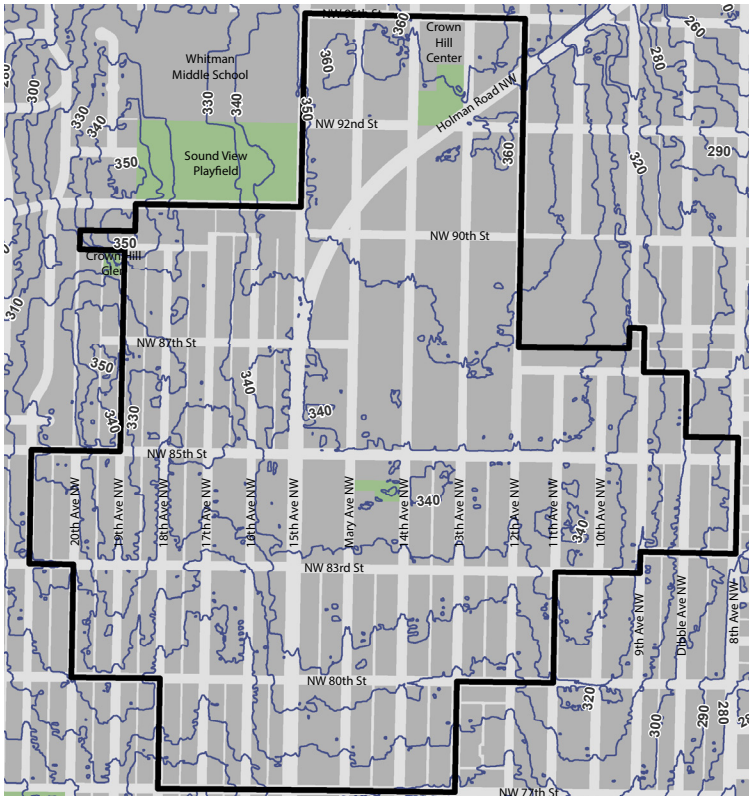


Figure 2.5.A **Crown Hill Topography.** Blue lines show 10’ contours.

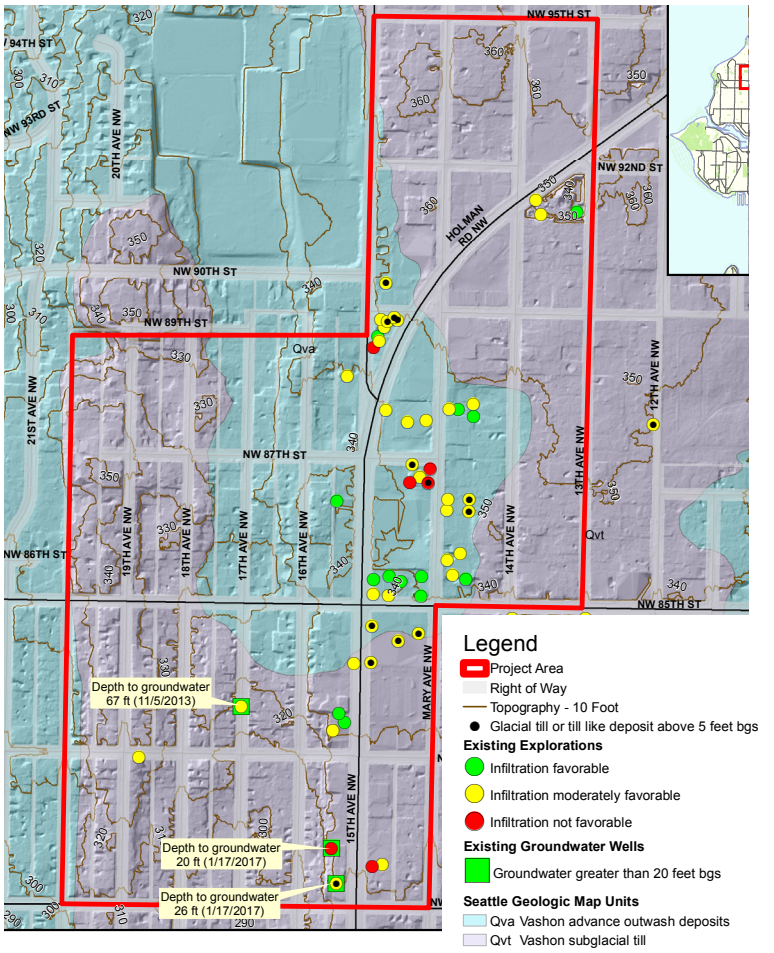


Figure 2.5.B **Soils and general infiltration potential.** *Outwash deposits (blue) generally allow faster infiltration than glacial till (purple).*

3.0 System improvements

Source: Crown Hill Urban Village Action Plan, OPCD

This section provides high-level guidance to inform system improvements over time, responding to the complexity of Crown Hill's infrastructure and drainage basins. It identifies specific system gap subareas in the neighborhood, establishes the relative priority of addressing those gaps, and makes recommendations on flow direction and conveyance type for each block. It does not include recommendations about pipe sizes, elevations, and alignments, because those details are best established close to the time of making the improvements. The sequence of improvements will change some of the specific needs for different blocks, future code changes and interpretations may shift what is needed to meet "Ensure Sufficient Capacity" and other requirements, and changing climate and neighborhood conditions may suggest different solutions at the time of implementation.

A "drainage conveyance system gap" in this analysis means a block that lacks stormwater conveyance entirely, or one that has drainage infrastructure unlikely to meet long-term needs as the block redevelops (this includes ditches, culverts, and partial storm drains). While the sewer system in Crown Hill doesn't have conveyance system gaps, there are some capacity risks. In most cases, these appear to be caused by downstream constrictions rather than inadequacies in the local sanitary sewer system (see Section 3.4).

System gaps and capacity risks in the Crown Hill stormwater system are significant and won't be solved by a single party or project. Instead, system improvements will continue to happen over time through an incremental mix of capital projects by the City of Seattle and system extensions by private developers.

3.1 Prioritizing system gap areas

Most blocks north of NW 85th Street lack piped conveyance. To address these gaps in a coherent way, this plan organizes the gaps into nine subareas, each with shared characteristics about existing drainage infrastructure, land uses, flow paths, and discharge basins. These nine gap areas vary in size, severity, and context. Figure 3.1.A shows the gap subareas and their relative priority, based on SPU's analysis. Table 3.1.1 below provides more detail on each gap area and the impacts of those gaps.

SPU's project team assessed the relative priority of system gaps. Prioritization in this analysis relates to how important drainage in a given area is to resolving existing capacity risks and accommodating future development. It does not indicate responsibility for who fixes the gap – that question is addressed separately in section 3.4.

Primary factors in establishing system gap priority:

- **Lack of infrastructure to carry existing flows.** Is there already some form of drainage conveyance?

- **The block's role in conveying flows from a larger area upstream.** A gap that only affects local street drainage and future development connections is assigned a lower priority, whereas a gap that affects a broader regional drainage catchment is assigned a higher priority.

- **History of sewer or flooding problems.** Known flooding or sewer backups, especially for frequent and larger scale events, is high priority. Similarly, modeled system capacity risks indicate areas with a higher need for system improvements.

Secondary factors in establishing system gap priority:

- **Existing and potential density of jobs/residences.** Based on adjacent land use observations and zoning, with consideration of differences at block scale. One of SPU's mandates in the City's Comprehensive Plan is to provide infrastructure that supports growth in our designated urban growth areas. Given how many gaps exist around Seattle, it's hard to prioritize improvements in lower density blocks if they don't also have acute stormwater or sewer problems. Zoning is a proxy for this factor.

- **Likelihood of future redevelopment.** Blocks with more redevelopment potential are a higher priority to address the gap – we get better and more consistent outcomes with an up-front investment, compared to piecemeal improvements over time.

- **Street function.** Streets with special designations (neighborhood greenways or priority freight, bike, or pedestrian streets) are a higher priority than other streets.

The system gap prioritization informs this plan's recommendations about timing and approach for addressing the gaps (Section 3.4).

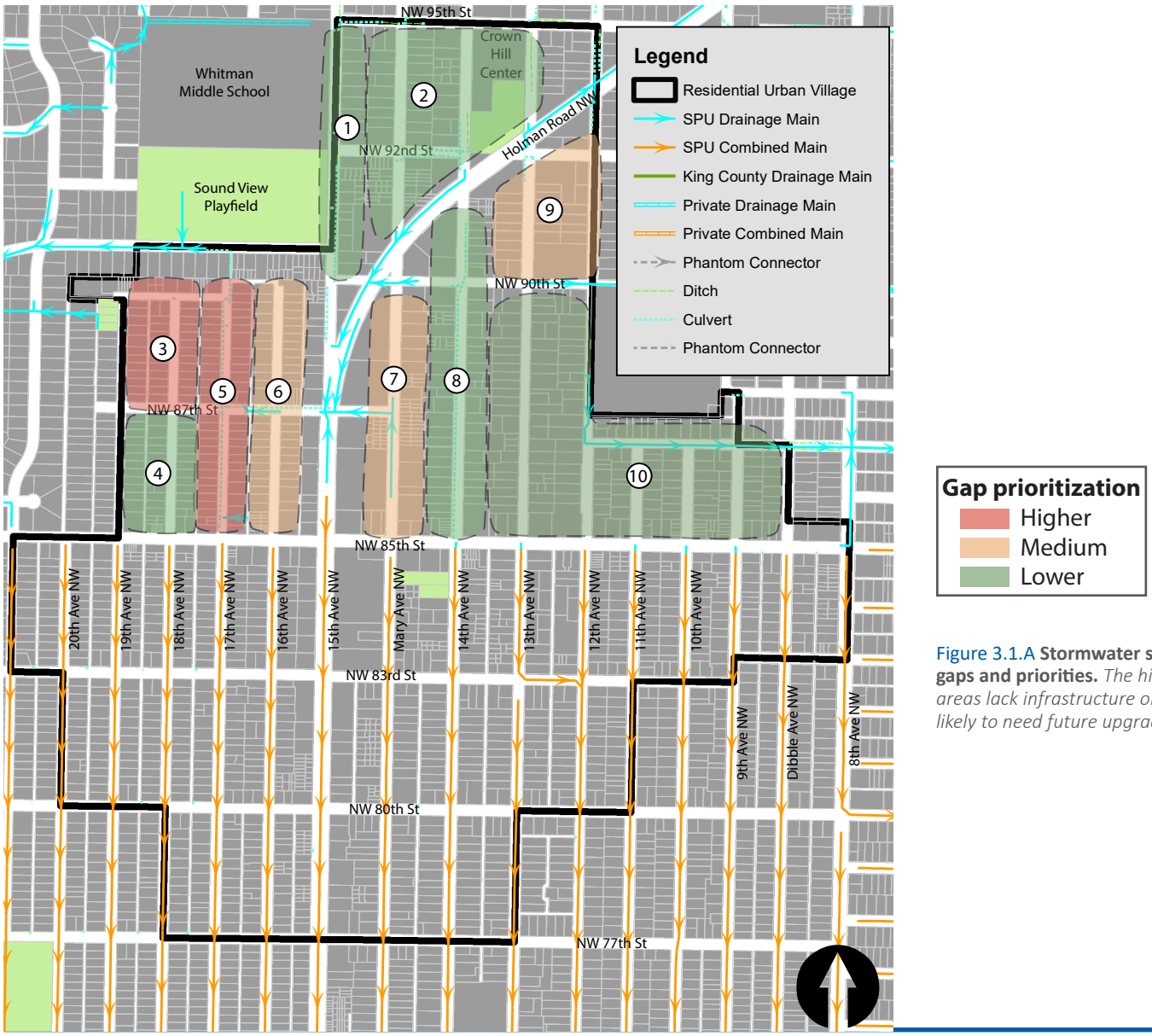


Figure 3.1.A **Stormwater system gaps and priorities.** *The highlighted areas lack infrastructure or are likely to need future upgrades.*

Table 3.1.1 **Assessing Crown Hill drainage system gaps (refer to Figure 3.1.A)**

Gap Area	*Primary Factors*			*Secondary Factors*			Relative priority	Notes
	Conveyance type	Flow from up-stream?	Observed or modeled problems?	Adjacent zoning*	Redev. potential	Street function		
1	Culvert (partial), gap	No	Southern block flows to flooding on 17th Ave NW.	NC, LR, RSL	Low	Minor arterial	***LOWER***	See Figures 3.2.2A and 3.2.2B
2	Storm drain (partial), bio retention, gaps	No	Reported minor street flooding.	RSL, LR	Med	Local access	***LOWER***	2023 development extended the storm drain, added GSI.
3	None/private	No	Reported & modeled flooding, sewer risks btw NW 87th & NW 89th	RSL	Med	Local access	***HIGHER***	See Figures 3.2.1A to 3.2.1C
4	None	No	None	RSL	Med	Local access	***LOWER***	Surface flows run to the south
5	Culverts	Yes	Reported & modeled flooding btw NW 87th & NW 89th, sewer risks to the south	RSL	Med	Neighbor-hood Greenway /Healthy Street	***HIGHER***	Existing culvert system is the spine for north Crown Hill drainage.
6	None	No	None, but modeled sewer risk to the south	LR	High	Local access	***MED***	Parcels flanking NW 87th may allow drainage to the ditch/ culvert system on 87th. Otherwise, drain to north and south.
7	Partial storm drain	No	None, but modeled sewer risk to the south	NC, LR	High	Comm ercial access	***MED***	Extending storm drains on Mary Ave NW may increase peak flow to the existing problems on 17th Ave NW.
8	Culvert	No	None, but modeled sewer risk to the south	LR, RSL	Med	Local access	***LOWER***	Culvert seems to have capacity for existing flows, may require eventual upsizing
9	None	No	None	NC, LR	Med-high	Local access	***MED***	Frontage along Holman and 90th has storm drains; only the north/south blocks lack conveyance.
10	None	No	None, but modeled sewer risk to the south	RSL	Med	Local access	***LOWER***	Surface flows run mostly to the south.

NOTE: Zoning abbreviations:
NC = Neighborhood Commercial – higher density zone for both residential and commercial construction;
LR = Lowrise multifamily zone – townhomes and similar scale structures for residential;
RSL = Residential Small Lot – like single-family zones but allowing two houses per lot, or duplex-scale residential development.

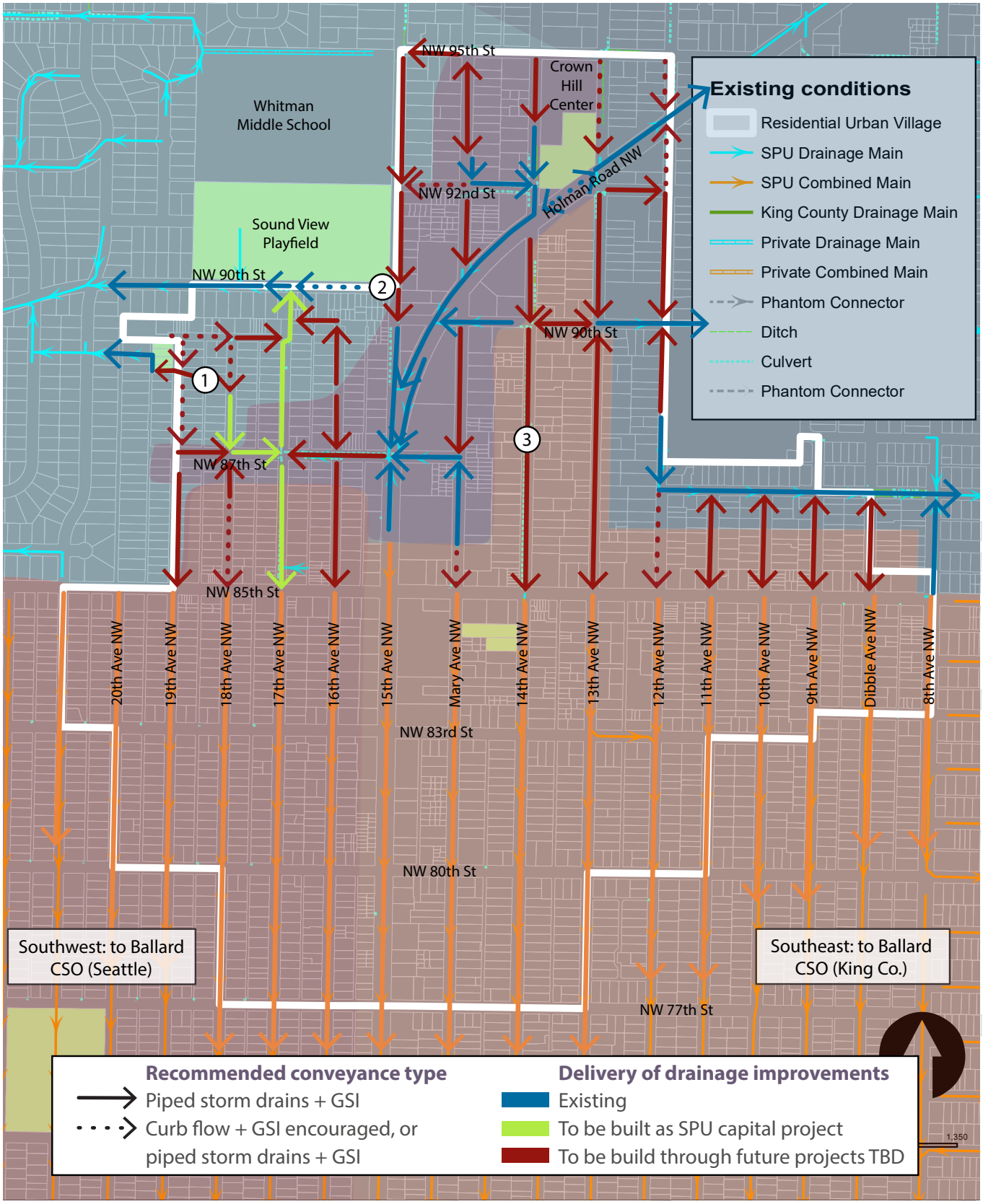


Figure 3.2.A **Recommended flow paths and conveyance types.** *Based on the principles in Section 3.3, this figure recommends flow direction for future system improvements. It also summarizes where storm drains should be required and where projects requiring conveyance may use curb and gutter OR piped storm drains. (Asterisk denotes blocks where a future project electing to add piped conveyance would route flows in one direction, but a project using curb and gutter conveyance would flow a different direction).*


Source: Seattle Times

3.2 Recommendations on stormwater flow direction and receiving basins

SPU reviewers determine whether development projects will be required to extend sewer and stormwater conveyance. They also decide whether the size and type of proposed extensions are acceptable, and in some cases what peak flow mitigation and downstream system improvements are required. If multiple flow paths are possible, they determine which flow direction(s) are acceptable for the development project to use. Based on close analysis of Crown Hill constraints and opportunities, this section provides guidance for future regulatory review.

After analyzing potential connections to nearby stormwater infrastructure, the Crown Hill planning team recommended the flow directions in Figure 3.2.A for future conveyance improvement projects. Site-specific analysis for future projects may result in different recommendations, but based on information available during this analysis, these flow directions appear to be the most feasible.

During initial planning for Crown Hill, the SPU team saw potential for reducing capacity risks by redirectly flows from existing routes to alternate trunk lines or even different basins. After further vetting, the team found that most of these changes would cause new problems and/or violate agreements with King County - consequently, the recommended system layout mostly follows existing flow paths.

Most blocks show one flow direction in Figure 3.2.A, and the connection to the receiving downstream system should be clear. When a block shows arrows in two flow directions, it suggests that development on that block may choose to connect to either end, depending on where the point of discharge is located and whichever path what make the shortest extension.

Potential for alternate stormwater flow patterns

In three locations on Figure 3.2.A, there are multiple options and not enough information to make a recommendation without more knowledge of how the neighborhood will redevelop over time. Each of these cases will take more study when a public or private project requires conveyance improvements; the preferred direction will be established through analysis by the project's design team and/or SPU reviewers and system planners during the design process.

Location 1. Between NW 87th St and NW 90th St, one and a half residential blocks sit in a depression, draining to the middle of the block. Some of runoff pools on private property, and some pools in the alley, where it has a de facto outlet to the sanitary sewer through a sewer lid (See further discussion in Section 2, "Area C1" – this location is both a capacity risk area and a conveyance system gap).

SPU's planned capital project for 17th Ave NW includes a drainage extension to 18th Ave NW that will drain about half of the flow out of this depression. If flooding persists after the project is complete, more conveyance and/or infiltration may be required of future projects. Three options may be feasible. All present challenges, but could solve the flooding separately or in combination:

A. Redeveloping parcels may be able to mitigate their own runoff through on-site infiltration (bioretention and/or UICs). Soil testing indicates good shallow and deep infiltration potential in the area, and anecdotal reports from homeowners also support this.

B. SPU could ask King Co. to formally approve draining stormwater into the sanitary sewer in the alley. This may require renegotiating KC/SPU agreements like the Joint Project Agreement or the Wastewater Contract; a lengthy process with uncertain outcome. But if other SPU projects reduce the volume of stormwater entering the Ballard combined sewer storage tunnel and/or reduce sewer flows going to the North Beach pump station (See Section 3.4), King Co. may be more receptive to this idea. Pursuing this option would require further legal review.

C. Applicants or SPU could request an easement from Seattle Parks and Recreation (SPR) through Crown Hill Glen, sending a new drainage mainline west to the storm drain on 20th Ave NW. SPR approval is not assured, and any new pipe through the natural area would require removing trees; public resistance and environmental review process may be substantial. Further, this option may be opposed by SPU since the utility prefers to avoid infrastructure through easements, due to maintenance challenges.

Options 1A or 1C could be pursued by developers as strategies to meet requirements about point of discharge and ensuring sufficient capacity. They could also be pursued by the existing residents through a local improvement district, whereby affected properties could pool resources to pay for a solution. Option 1B would require action by SPU.

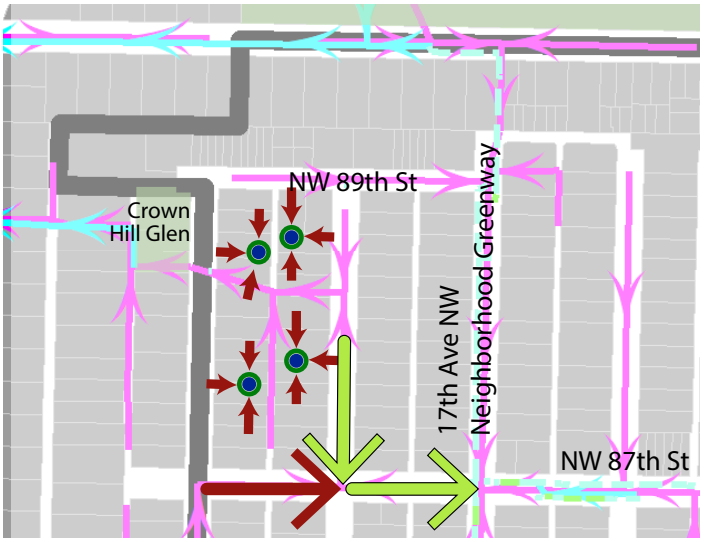


Figure 3.2.1A **Option 1A: Distributed Local Infiltration (see legend, next page)**

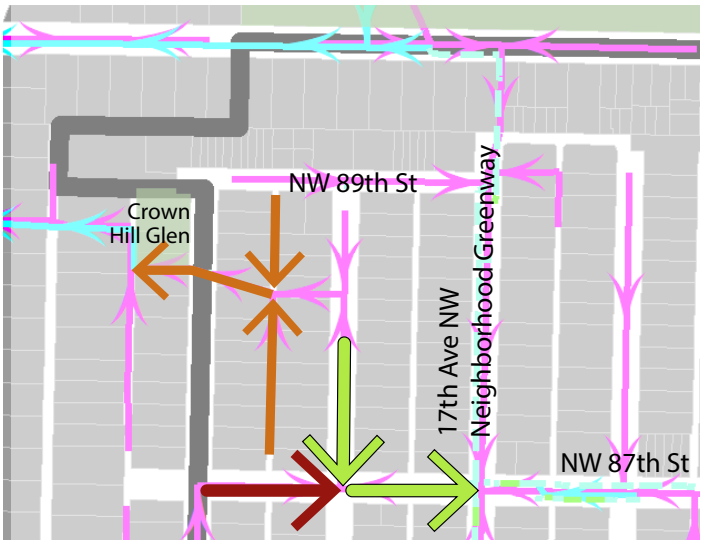


Figure 3.2.1B **Option 1B: Allow drainage into existing sewer lines, converting this subarea to a combined sewer.**

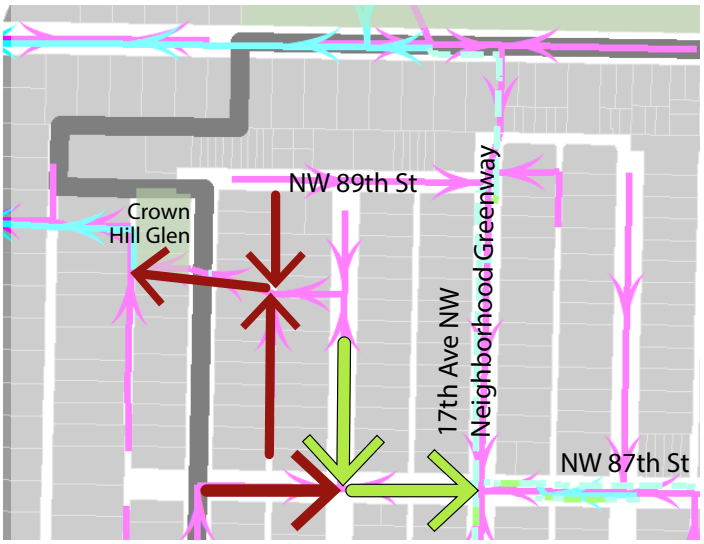


Figure 3.2.1C **Option 1C: Add new storm drain collectors and outlet**

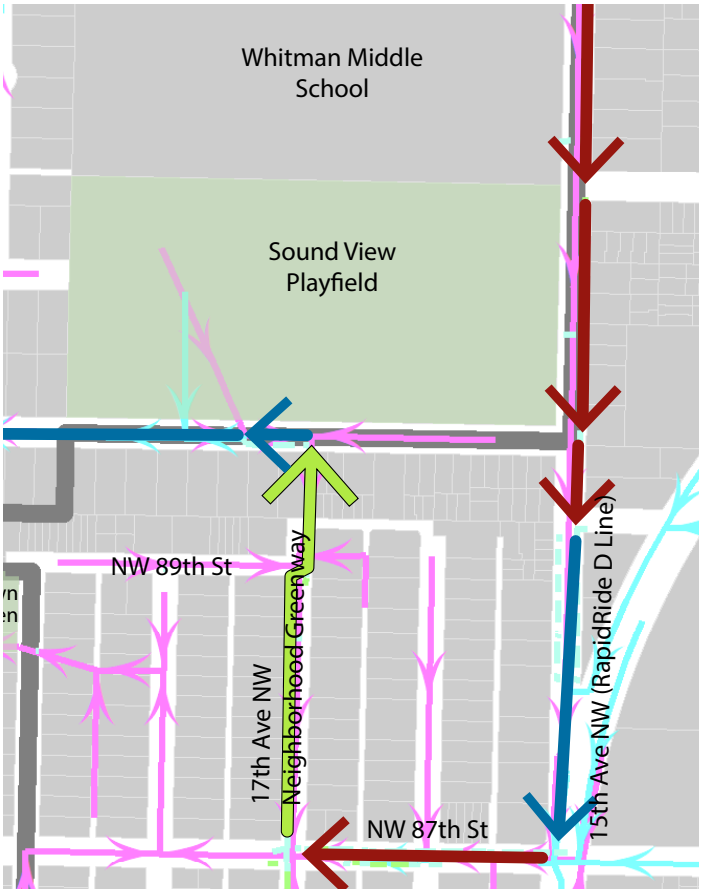


Figure 3.2.2A **Option 2A: Formalizing exisiting flow pattern**

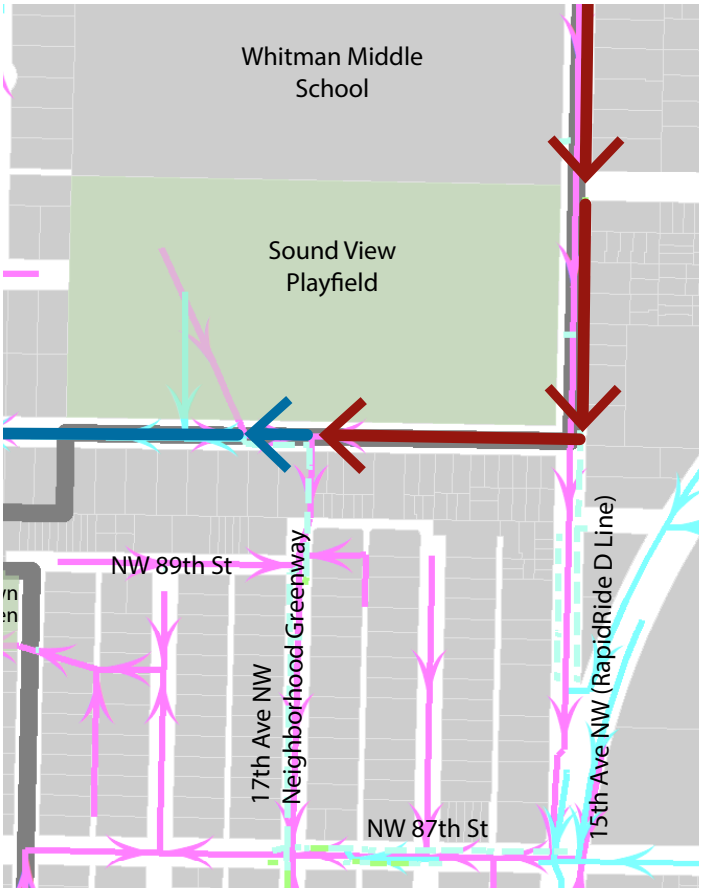
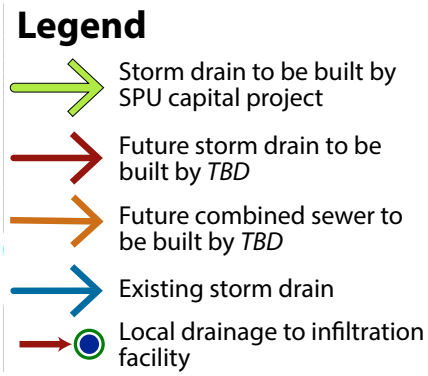


Figure 3.2.2B **Option 2B: New connection on 90th**



Location 2. The block of 15th south of NW 92nd Street currently drains south and west to the flooding area at NW 87th Street. Future piped conveyance improvements appear to have two options:

A. Continue that same flow pattern, through formalized storm drains to the south and west on NW 87th Street.

B. Route flows from this block west on NW 90th Street through a new storm drain, bypassing the flooding area at NW 87th St.

Location 3. The culvert on 14th Ave NW does not have known capacity risks, and it may be deep enough to accomodate drainage from parcels on either side of the street. Development along these blocks may or may not require upgrading the culvert to a piped storm drain. To inform SPU's future decisions about improvements, SPU or project proponents will need to gather more information about the pipe depths and conditions. Specifically, CCTV inspections for pipe condition and new modeling to look at long-term capacity with increased development would help inform decisions about this asset.

3.3 Conveyance types and street typologies

While a fully built-out separated storm drain system with pipes under every block is the standard engineering approach to building out urban neighborhoods, other options may be better in some situations. A complete grid of piped storm drains has high predictability and convenience for development, but it's expensive and disruptive to build in an existing urban neighborhood, it doesn't slow or treat polluted stormwater runoff, and in many situations has to be paired with detention systems to make sure that new pipes don't cause or worsen downstream flooding.

This section recommends some approaches to stormwater conveyance within the Crown Hill urban village that differ from current standard SPU practices on stormwater conveyance. SPU has not assessed the implications of applying this approach in all informal drainage areas, so further consideration is needed before applying these recommendations more broadly. While the notes below are oriented toward infrastructure improvements required of development projects, they also apply to capital projects by SPU, SDOT, or other agencies.

Conveyance types

Before considering location-specific recommendations, here are descriptions of options for stormwater conveyance.

Pipe storm drains (PSDs). As the longstanding default approach, storm drains are the conveyance strategy best covered by standard plans and details. Where they exist, they provide a predictable point of discharge for new development projects. However, they are often the most expensive option to build and maintain. Further, piped storm drains collect and transport stormwater flows so efficiently that they can worsen downstream flooding, sewer overflows, and/or creek erosion by sending larger, faster peak flows. Per Director's Rule DWW-210 and regulatory practices at the City, projects with less than 5,000 sq ft of new and replaced hard surface are generally allowed exemptions from PSD extension requirements. Projects above that threshold are generally required to provide PSD extensions.

Existing ditch-and-culvert systems. As in much of north Seattle, the north half of Crown Hill was developed as unincorporated King County, with lax engineering standards for a lower density, semi-rural context. When stormwater conveyance was provided, it was usually in the form of ditches and culverts. In most cases, ditches don't meet the City's current standards for pedestrian safety or accessibility.

Figure A ditch on NW 17th Street running high - because this segment receives high flows from upstream and is relatively flat, it tends to clog.

As residents and businesses wanted more space in the right-of-way, they replaced portions of the ditches with shallow culvert pipes. Culverts are typically shallower and smaller diameter than piped storm drains, and usually are not engineered. Because of their patchwork nature and unpredictable connections, culverts often present flooding risks and maintenance challenges. To meet other development requirements such as street improvements, parcel access, and solid waste staging areas, capital projects or developers often need to convert existing ditch-and-culvert systems to piped storm drains.

Curb and gutter. Concrete curb and gutter conveyance, usually in conjunction with sidewalks and planting strips, has long been accepted by SPU for distances of less than 360' feet. Many neighborhoods (such as Ballard, Magnolia, North Beacon Hill…) use curb and gutter conveyance for entire 600-700' blocks, with collected runoff entering catch basins at intersections. Curb and gutter conveyance offers some cost savings and performance benefits, which are discussed in the following section ("A hybrid approach for Crown Hill").

Conveyance swales. Early in the process of developing this Crown Hill Drainage & Sewer Plan, SPU explored the use of conveyance swales as an alternative to storm drains. Conveyance swales are shallower than traditional ditches, using bioretention soil to encourage shallow infiltration, decrease the runoff volume, and improve water quality. However, after many months of exploring conveyance swale options, the project team found that conveyance swales will rarely be the best option within denser, mixed-use neighborhoods like this one. This decision was informed by the following constraints:

- Space in the right-of-way is limited, especially in urban villages. Unlike piped systems, swales require right-of-way width to provide conveyance capacity, often 10' plus. While it's rarely easy to fit all of the elements of a complete street into the right-of-way, it's hardest in denser mixed-use areas which have a higher density of pedestrians, bikes, cars and trucks, parking, services, and utilities. Specifically, it's often impossible to carve out long continuous stretches needed for conveyance swales while also providing sidewalks, load/unload zones, parking, trash staging areas and adequate travel lanes.

- When used for conveyance down multiple blocks, they tend to quickly get too deep and/or present challenges for getting flow under intersections. This is a major constraint within Crown Hill, but may be less of a problem in neighborhoods with steeper slopes.

- Swales pose challenges for the City's required street improvements. On most blocks there's not room for swales on both sides of the street, so the logical strategy would be to put the swale on the lower side of the street and direct all runoff there. This kind of asymmetrical configuration tends to allow pedestrian improvements on one side while requiring stormwater improvements on the other. Getting this configuration from incremental infill development presents sequencing challenges, and would put reviewers in the position of requiring very different improvements from different developers. SDOT is generally only willing to grant street design deviations for this approach when one party (public or private) is improving the entire block in a unified project.

While conveyance swales don't work as a standard conveyance system in Crown Hill, they may be an appropriate option in some circumstances. When SPU explores conveyance swales further in other areas, several issues will need to be resolved. Most importantly:

- Standardized design. The conveyance swale detail in the City's Design Standards & Guidelines does not have widespread buyoff from SPU engineers for broad application. It may be necessary to develop two options: one for basic conveyance, and one for basic conveyance, and one for conveyance plus detention storage (i.e., with subsurface components, bioretention, pipes, etc.).

- Maintenance practices and responsibilities. SPU doesn't have the resources to take on vegetation management for swales that provide conveyance alone, but maintaining them the same way SPU maintains ditches will cause swales to turn into ditches over time. There may be flexibility to take on management of swale-like facilities if they meet specific engineering performance requirements for water quality or flow control. Clarity around how these facilities will be maintained and who will do it is important before any widespread application of swales.

A hybrid approach for Crown Hill

System improvements should provide a connected, well-functioning network that protects water quality, preserves affordability, and reduces risks of flooding and sewer backups. After evaluating various alternatives, the project team recommends expanding the network of piped storm drains on most blocks in north Crown Hill to provide a reliable framework of drainage collectors, while allowing some blocks to have the option of using curb and gutter conveyance to meet local drainage needs - including for development above today's thresholds for PSD extensions.

Curb and gutter conveyance blocks in this hybrid approach offer the following benefits:

- **They can lower total construction and maintenance costs** of building out the neighborhood's infrastructure, while also reducing construction impacts. Under existing rules, developers and/or the City would need to pay for sidewalks, curb and gutter, and piped storm drains throughout the neighborhood over time. Relying on curb and gutter to provide local conveyance can reduce the total number of piped storm drains required, reducing the overall cost burden.

- **They provide more opportunities to manage flows with green stormwater infrastructure** by keeping collection and conveyance at the surface. While continuous conveyance swales are very difficult to fit on Crown Hill streets, GSI curb bulbs mid-block and at

corners are often feasible by using the planting strip and the flex zone in the right-of-way. This GSI can slow and treat flows, and where infiltration is feasible, reduce total volume before discharging to the piped storm drain collectors. While this GSI wouldn't be required as part of extensions, it would present an excellent "beyond code" partnering opportunity and/or retrofit opportunity (see Section 3.5).

- **It could lead to faster build out of the neighborhood's missing sidewalks.** SDOT rules only require development to provide sidewalks abutting their parcel, but if developers elect to use curb and gutter conveyance instead of PSDs, they will need to provide continuous paved pathways to the end of the block.

While curb and gutter conveyance has some advantages for local drainage, it doesn't work everywhere: suitability at the block scale depends on specifics like street slope, block length, and adjacent parcel imperviousness. SPU Director's Rule 210 establishes gutter spread maximums to maintain safe travel routes during storms. A 2024 consultant study helped establish guidance for which blocks are most likely to stay below the maximum curb spread allowance - see Table 3.3.1 for a summary.

Recommendations in this section are valid for both City-led capital projects and development-led projects that trigger conveyance extensions.

Several additional factors must be considered as part of implementing this conceptual layout:

- **SDOT pedestrian requirements.** Development in Crown Hill is already required to provide "frontage improvements," i.e., sidewalks and planting strips. However, those requirements only apply to the portion of the right-of-way abutting the parcel. When a project applicant elects to use curb and gutter conveyance instead of a piped storm drain, SDOT generally requires that a sidewalk be provided along with the curb – consistent with ADA requirements and other liability concerns. In many cases this will extend the street

Table 3.3.1 **Criteria for determining allowable conveyance type (Osborn Consulting, 2024).**

Conveyance Requirements	Block Conditions	Notes:
Storm drain required *(extended to nearest downstream storm drain)*	• Block receives runoff from one or more uphill blocks; OR • Block sends runoff to downhill blocks that lack adequate stormwater infrastructure; OR • Block contains a low point/closed contour; OR • Block includes multiple parcels with elevations below the street; OR • Block doesn't meet criteria for safe curb spread (see below)	Bioretention and/or other features may also be required or incentivized to treat stormwater and/or mitigate peak flow*

Storm drain optional; Curb flow + GSI encouraged	• Block does not meet any of the "storm drain required" conditions (see above); AND
	• Block has positive drainage path to a piped storm drain at the downslope intersection (no mid-block low points); AND
	• Block meets criteria for acceptable curb spread:
	  • Street is crowned
	  • non-arterial street classification
	  • minimum slope of 2% if <300' flow length
	  • minimum slope of 3% if 300'-600' flow length, with flow control
	  • minimum slope of 5% if 300'-600' flow length, no flow control
		Bioretention and/or other features may also be required or incentivized to treat stormwater and/or mitigate peak flow*

***NOTE:** When public or private projects trigger a drainage extension, Stormwater Code doesn't typically require providing water quality or peak flow control for the newly connected right-of-way area. The exception to this is if a project will increase impervious area in the right-of-way by more than 50%. It's also possible that SEPA requirements may trigger water quality treatment.

improvements that a project would have otherwise been required to provide. The total project costs of sidewalk + curb and gutter may be more or less than adding a piped storm drain, depending on the individual site context. In these cases, SDOT may allow asphalt walkways behind the curb conveyance system beyond the frontage improvements, provided that the walkway is ADA accessible.

- **Incorporating flow control through requirements and/or incentives**. All blocks that lack conveyance in Crown Hill drain to a combined system that has known sewer capacity risks (see Section 2.4) or a separated system with drainage capacity risks. Formalizing drainage, regardless of the strategy used, can increase peak flow to these downstream problem areas. Capital projects by SPU or SDOT that formalize conveyance may be required by Stormwater Code's "Ensure Sufficient Capacity" rule to include bioretention or other BMPs to offset the effects of this concentrated flow. Parcel projects are required to mitigate their own runoff to meet flow control requirements, but if they're also required to extend conveyance (piped or curbed), no flow control requirement applies to that street runoff; this scenario is a good opportunity for "beyond code" GSI partnerships between SPU and developers (see Section 3.5).

- **Length of required extensions**. According to code, if a development triggers a drainage extension, the City may require that project to provide conveyance however far is needed to reach the downstream point of discharge. In practice, SPU rarely requires conveyance extensions of more than one block for parcel-based development projects. For properties more than one block from the nearest storm drain, on-site management through full infiltration is allowed instead. Fortunately for Crown Hill, most parcels that lack adjacent conveyance are within one block of a storm drain or acceptable culvert. In those areas where a storm drain extension would discharge to a ditch or culvert system, SPU should consider partnering to construct downstream infrastructure beyond the one block improved by a project proponent.

- **Pumping and discharging from parcel to main**. In areas where flow control requirements apply, many parcel projects will include underground detention systems, which would require pumping to a point of discharge at the curb. Many of these projects already have pumps to get water from the bottom of tanks into a storm drain, so this is a manageable challenge.

Figure 3.3.A **Crown Hill Street Type Designations** (per Streets Illustrated)

Street typologies

While adequate drainage is crucial for safe and well-functioning neighborhoods, many other elements must fit together in the right-of-way to make a successful street. As a basis for regulating street improvements, SDOT uses a web-based guide called Streets Illustrated. This resource designates every street in Seattle as a particular street typology, each with its own guidelines for sidewalks, planting strips, "flex zones", and travel lanes. Figure 3.3.A summarizes the Streets Illustrated designations for each of Crown Hill's streets, along with right-of-way widths. Most streets that will require stormwater and pedestrian improvements are designated either "Urban Village Neighborhood Access" or "Neighborhood Yield."

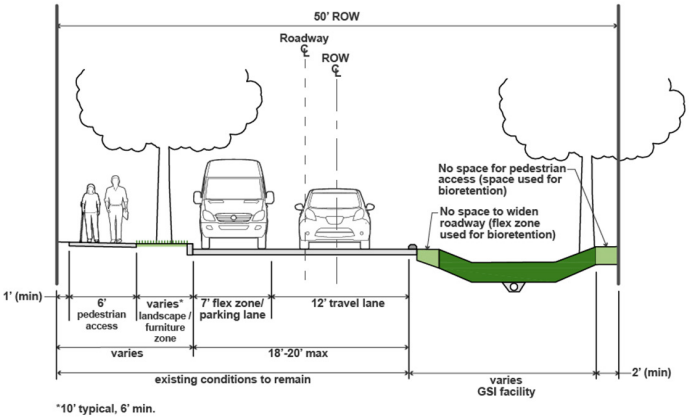


Figure 3.3.B **Curbless Urban Village Neighborhood Access street type 50' ROW.** *Cross section showing where bioretention bulbs out into the flex zone/planting strip.*

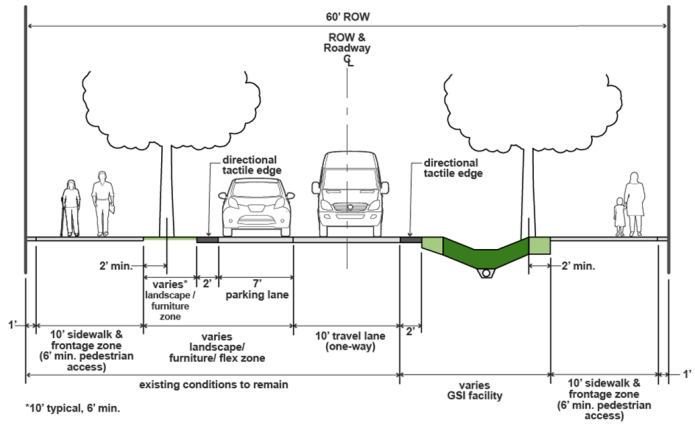


Figure 3.3.C **Curbless Urban Village Neighborhood Access street type 60' ROW.** *Cross section showing where bioretention bulbs out into the flex zone/planting strip.*

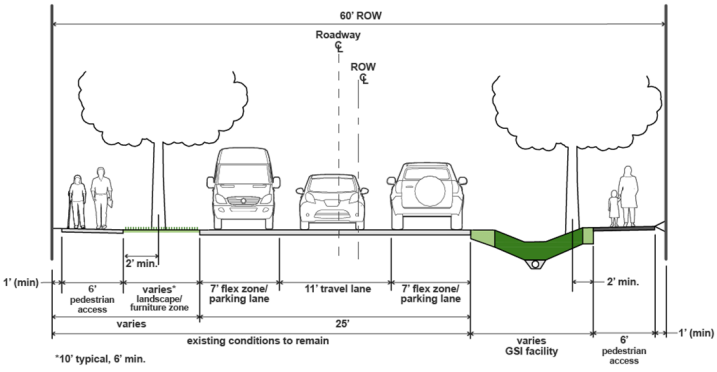


Figure 3.3.D **Curbless Neighborhood Yield street type 60' ROW.** *Cross section showing where bioretention bulbs out into the flex zone/planting strip.*

In many cases, the Streets Illustrated typologies lack specificity about how to fit bioretention along with other required elements. SPU continues to work with SDOT to adapt the typologies to accommodate GSI; Figures 3.3.B, 3.3.C, and 3.3.D show the updated guidance for the most common street conditions in Crown Hill. Until these concepts are incorporated in the next major update of Streets Illustrated, use of these configurations will require approval by SDOT's Deviation Committee; generally this guidance is intended for larger scale, City-led projects and not parcel-by-parcel redevelopment.

3.4 Sewer conveyance improvements

The sanitary sewer system in Crown Hill is relatively complete and adequate, compared to the drainage conveyance system. Clusters of sewer-related claims are confined to a limited number of blocks on 17th Ave NW and 18th Ave NW, and some of the challenges in this subarea will be lessened through SPU's capital improvements on 17th Ave NW.

However, there are some known sewer capacity risks and maintenance challenges, as previously described in Section 2.4, which should be managed in the long term. Six of the north/south avenues have modeled capacity risk of "medium" or "high", and one area has a large sewer catchment draining through difficult-to-access easements. From an analysis of the flow paths from these risk areas, it appears that a small number of downstream constriction points may be a significant contributor to lessened capacity. Figure 3.4.A shows clusters of sewer capacity risk areas, paired with their respective downstream constriction points.

In any of the following scenarios, rerouting flows would require additional modeling to check for impacts on downstream capacity, and more trigger additional pipe upsizing beyond what is described here.

A. **West Crown Hill sewers (flowing south)**. The north/south sewer lines with capacity risks west of 15th Ave NW drain south to the Ballard combined sewer system all flow to a trunk line on 20th Ave NW, starting at NW 65th Street. Between NW 65th and the Ship Canal, at least one and possibly multiple constrictions limit peak flow in a way that's likely to raise the hydraulic grade line for everything upstream. The greatest pinch point appears to occur where a 36" trunk line goes into a 12" pipe at the intersection of NW Market Street and 24th Ave NW. This is part of the flow split system that directs sewage to the treatment plant, a CSO outfall, and/or the storage tunnel – redesign in this area will be complex and closely related to regulatory compliance.

B. **East Crown Hill sewers (flowing south)**. From 15th Ave NW to 10th Ave NW, the east side of the Crown Hill Urban Village drains south via a trunk line on 11th Ave NE. That trunk line has about half the combined capacity of the two trunk lines feeding into it, likely constricting the flow from the upstream area. Pipe sizing and the extent of work will depend on the capacity of the downstream system and performance of the Ship Canal storage tunnel. Resizing would also need to be coordinated with King County Wastewater Treatment Division (WTD), as this system drains to a King County combined sewer outfall.

   While sewer capacity risks on 15th Ave NW drain to the same constricted line on 11th as the rest of Area B, the heightened risk on 15th appears to result from another bottleneck where 15th Ave NW approaches NW 65th St; an 18" pipe flows to a 14" pipe, combined with a right angle turn and some adjacent large, highly impervious contributing parcels. Conveyance improvements at this pinch point would likely reduce risks to on 15th, but would need to be part of a larger analysis with the 11th Ave NW main and King County coordination.

C. **Northwest sewer main (flowing northwest)**. Many blocks in north Crown Hill convey sewage west through a trunk line that passes through easements, and which also has sewer capacity risks (See discussion of Area C2 in Section 2.4, and Figure 2.4.F). The modeled capacity risks along this flow path appear to be the result of a relatively large subcatchment with two bottleneck segments of 8" diameter pipe (Figure 3.4.A). The first option for addressing this risk is to upsize the pipe in those bottleneck areas, keeping the existing flow pattern but reducing risk (Figure 3.4.B). This option would not address the maintenance challenge of a large part of Crown Hill conveying sewage through difficult-to-access easement areas.

   An alternative "Option 2" would be to send less flow to the northwest; if sewer capacity risk clusters A and B (from figure 3.4.A) have been resolved to the south, there may be opportunities to tie sewer mains north of NW 85th Street directly to the combined sewer mains south of NW 85th Street, distributing flow more broadly and directing it away from the easement area. Mary Ave NW, 16th Ave NW, and 18th Ave NW appear especially promising locations for redirecting flow, since they don't have current capacity risks immediately downstream (Figures 3.4.C). Implementation of this option may require approval by and agreements with King County WTD.

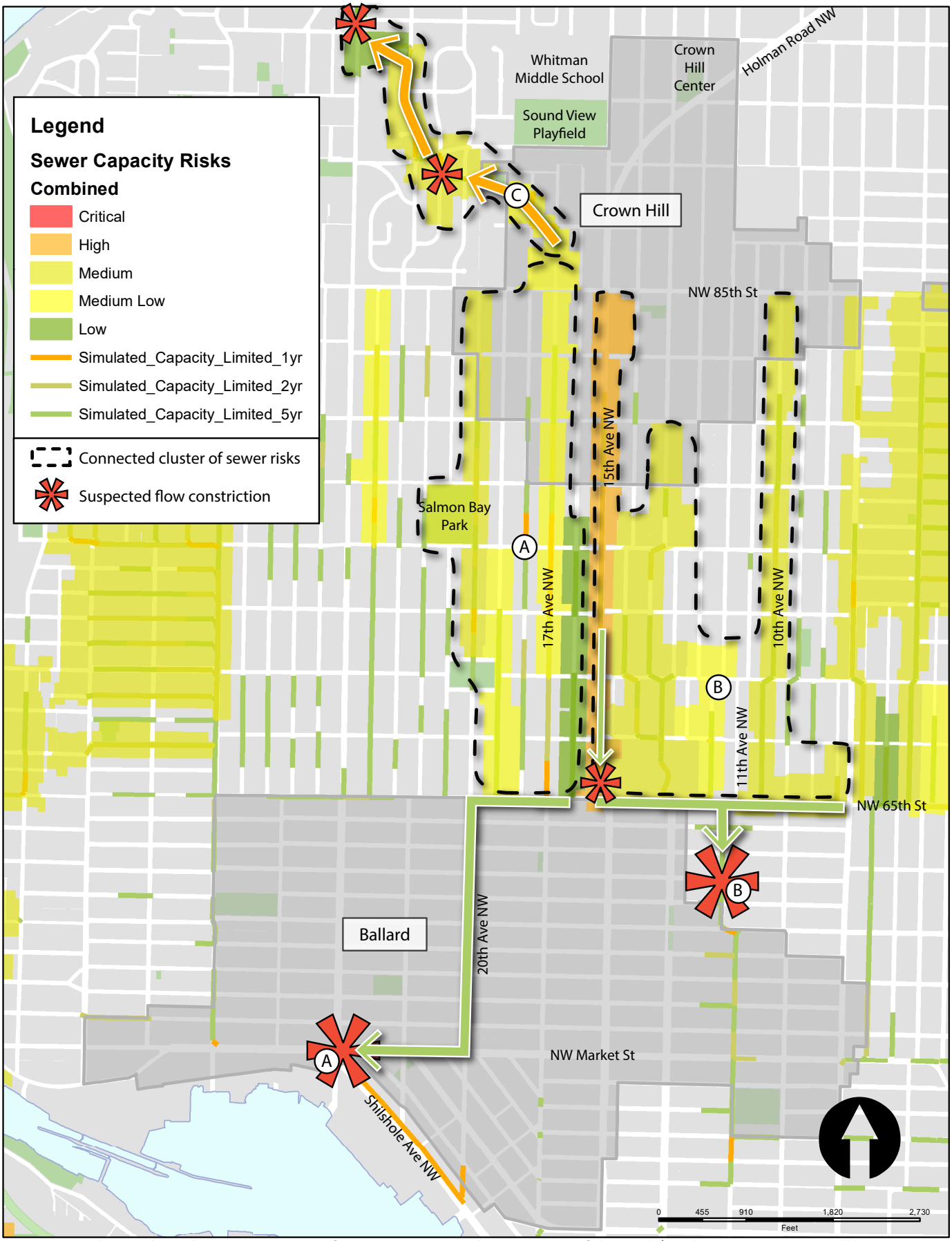


Figure 3.4.A **Flow paths and constriction points for sewer capacity risk areas.** Many of the north/south avenues in Crown Hill have some level of sewer capacity risk, identified through the Wastewater System Analysis. It appears that many of these risk areas come from a relatively small number of flow constriction points in the downstream system.

Figure 3.4.B **Option C1: Maintain existing sewer flow.** Capacity risk in this scenario could be reduced by fixing a downstream flow constriction to the northwest (see problem "C" in Figure 3.4.A). The portion through easements would continue to be a maintenance challenge.

Figure 3.4.C **Option C2: Partial reroute to Ballard Combined Sewer.** Rerouting much of the upstream flow south through the Ballard CSO could help relieve the capacity and maintenance risks, but is only recommended if constrictions to the south have been fixed first. Also, portions of this option may require approval by and agreements with King County.

3.5 Implementation strategies

The process of improving the stormwater and sewer systems in existing urban neighborhoods depends on a variety of actors making improvements over time. Like many other neighborhoods with drainage gaps, Crown Hill will rely on a combination of City investments (mostly SPU and SDOT) and private development projects to improve system reach and capacity, reducing present and future risks. This section describes the main mechanisms for implementation.

Code-required conveyance improvements

Seattle's Stormwater Code and supporting regulations give SPU and SDCI authority to require drainage extensions to support development. As discussed in Section 3.3, sometimes that may be in the form of piped storm drains, in other cases curb and gutter conveyance may be allowed. Some general thresholds for drainage extension requirements are as follows, summarized from SPU Director's Rule DWW-210:

- Parcel-based projects with 5,000 square feet new and replaced impervious surface.
- Right-of-way projects where new plus replaced hard surface is 50% or more of the existing hard surfaces within in the project limit (most often triggered by SDOT projects or major utility work).
- The Director has broad latitude to require extensions wherever they're needed to protect public health and safety, property, use of the right-of-way, or where a project may adversely affect flooding, sewer capacity risks, or environmentally critical areas. As noted in Section 3.3, SPU does not typically require developers to extend drainage more than 600', unless a project is unusually large or presents specific downstream risks.

If new development assembles lots and redevelops them together as a large site, the resulting project will exceed extension thresholds and conveyance improvements would happen rapidly. In many of the lower priority gaps in Residential Small Lot zones, single-lot projects are likely to stay under the storm drain extension thresholds, so some of these gaps may not be filled in the foreseeable future by redevelopment. This generally seems acceptable as long as no acute drainage problems exist. All projects in urban villages are required to make frontage improvements including sidewalks and planting strips, so at a minimum, curb and gutter improvements will occur gradually over time.

Extension requirements can also apply to sanitary sewers and combined sewers. All of Crown Hill has sewer mains available on the north-south streets. Many short blocks (east-west) lack sewer mains. SPU's general practice has been that larger mixed use or multifamily residential projects are required to extend the sewer main, and smaller infill residential can use shared side sewers to reach the sewer.

Code-required flow control

Seattle's Stormwater Code contains multiple requirements to mitigate the impacts of new development on water quality and system capacity. Any project in Crown Hill that exceeds code thresholds (generally, those having ≥5,000 sq ft hard surfaces) is required to meet the peak flow control requirement – either because of downstream capacity constraints, and/or because the site drains to a combined sewer. All projects above the thresholds also must meet on-site management requirements to provide a base level of stormwater best practices. Projects that drain to Pipers Creek (see Figure 2.4.B) have additional flow control requirements.

As noted, code implementation will only apply to parcels that redevelop and pass certain thresholds. Other parcels won't redevelop, or will redevelop while staying below Stormwater Code thresholds.

Areas that are likely to see general improvement include the blocks downstream from large parcels on 15th Ave NW and Holman Road; under existing conditions, those parcels are almost entirely impervious and most have no stormwater management facilities, but as they redevelop, most projects in this area will trigger peak flow control requirements.

Elsewhere, Stormwater Code may not fully mitigate the impacts of redevelopment within the lower density Residential Small Lot (RSL) zones. If an RSL development assembles two or more parcels and goes for full redevelopment, it will trigger flow control, drainage extensions, etc. Otherwise, infill on a single RSL lot is only likely to trigger On-Site Management. The effects of On-Site Management can be difficult to predict since there are multiple options to meet the requirement, but it's generally intended to achieve a flow rate similar to pre-developed forested condition for projects in a creek watershed, and to pre-developed pasture condition in all other basins.

Capital projects

SPU, SDOT, and King County Metro all make ongoing investments in maintenance and periodic upgrades of infrastructure in this and other urban villages/centers. SPU should continue to monitor that project pipeline and look for opportunities to make improvements in line with the recommendations in this plan.

Latecomer Agreements

Usually, when a developer is required to extend a storm drain or a sewer main, they bear the full cost of the extension, and subsequent developments can tie into the main for just the cost of their own connection. State Law (RCW 35.91) and Seattle Municipal Code (SMC 21.80) allow a special funding mechanism for stormwater and wastewater improvements called a "latecomer agreement," which allows the first developer to recoup a portion of their costs from each later development that connects to the new infrastructure. Latecomer agreements must be approved by the City, and they're typically effective for 15-20 years from the completion of the infrastructure improvements.

These agreements have already been used by some private developers in Seattle ("private latecomer agreement"). While code allows the City to apply these agreements to our own projects ("municipal latecomer agreement"), SPU has not done so yet. The improvements on 17th Ave NW may be a good candidate to test this: if SPU solves multiple system problems with a capital project here, it reduces the need for future upstream projects to figure out and implement their requirements for Ensure Sufficient Capacity, adding predictability to their permitting process. It would also provide an equitable strategy to make sure that future development shares the cost of the infrastructure it uses. If this mechanism is effective at repaying SPU for some capital project costs, it could extend the utility's ability to build gray/green capacity improvements in urban villages.

Latecomer agreement areas for further analysis:

- **Sidewalk partnerships.** Under state law it's legal to apply latecomer agreements to pedestrian improvements like sidewalks too, but there are not yet provisions in Seattle Municipal Code to allow this application. After SPU pilots latecomer fees on utility projects, it may be worthwhile to support SDOT developing a parallel program through revisions to the code and setting up administrative processes. Often, sidewalk gaps and drainage/wastewater gaps happen on the same blocks, so a coordinated approach would make sense.
- **Affordable housing partnerships.** SPU is generally restricted from using ratepayer funds to build infrastructure on behalf of affordable housing developments. Latecomer agreements could potentially offer more flexibility to extend conveyance to meet an affordable housing site , which could then pay back their share of the project, rather than shouldering the cost of the entire extension.
- **Curb and gutter conveyance.** More analysis is needed to determine whether curb and gutter improvements are eligible for latecomer agreements if they're part of a planned stormwater conveyance system.

"Beyond Code" green stormwater infrastructure incentives

In recent years, SPU has been building up tools to partner with developers and other City agencies to take projects beyond meeting Stormwater Code requirements in the places where we need broader system improvements. In these cases, SPU pays a developer or partner agency to include green stormwater infrastructure to manage more runoff than what would be required of the project through straight code compliance. This model has the potential to deliver more system improvements in less time by leveraging projects already going through the design, permitting, and construction pipeline.

An early example of this partnership model is Queen Mary Rowhouses, a market-rate rowhouse development near the Crown Hill Center at NW 92nd, between 14th Ave NW and Mary Ave NW. This project met the flow control requirements on site as required, but also included additional voluntary large bioretention facilities as part of

Figure 3.5.2 **Queen Mary rowhouse bioretention.** A pilot project for "Beyond Code" developer partnering, located just west of the Crown Hill Center.

their streetscape improvements. SPU paid the developer to construct these facilities, which will manage runoff from the uphill blocks to meet the peak flow standard.

New tools to support this type of partnership include a map showing eligible partnering areas (including most of Crown Hill), a technical memo that establishes a process for determining the financial incentives a project can get (see references), and agreement templates for partners interested in working with SPU.

Crown Hill includes many large likely development sites clustered along 15th Ave NW and Holman Road NW, many of which contribute to the capacity risks at 17th Ave NW and NW 87th Street (see Section 2.4). SPU reached out to many of these property owners or their agents in 2020; at that time, they didn't have imminent plans to redevelop, but some expressed interest in exploring incentives when they do redevelop. SPU staff should continue to monitor these sites for development permit activity.

GSI parcel retrofits

SPU has two programs that provide incentives for green stormwater infrastructure retrofits of existing sites. The contracting mechanisms and specific design options of each are different, but the basic idea is the same – in eligible areas, SPU pays a contractor to install rain gardens or rainwater harvesting systems on private property, and the property owner agrees to maintain that facility, reducing the stormwater flows to the public system. The two programs are:

- **RainWise.** This program delivers small scale retrofits, most often for individual homes on lower density blocks. Private property owners hire a contractor from a pre-approved list to install a cistern or raingarden and get a rebate from the City. Eligible blocks in Crown Hill are the blocks south of NW 85th St and east of 15th Ave NW that are upstream of capacity constrained sewers. Retrofits in this area have modest potential to reduce local sewer backup risks.

- **Rain City Partnerships.** This new program will be dedicated to retrofitting larger properties – many parcels along 15th Ave NW and Holman Road may be eligible (see purple area in Figure 2.3.B). Retrofits in this area would take pressure off the main flooding and sewer backup area. Rain City Partnerships is a new program, expected to launch later in 2024.

3.6 Strategies for specific system problems

Based on what we know about the neighborhood's system needs and opportunities, the project team recommends the following approach to the drainage gaps identified and discussed in the preceding sections (Tables 3.6.1 & 3.6.2).

In previous sections, this plan has identified two types of system problems: capacity risks, where observations and/or modeling have highlighted potential for flooding and sewer backups; and conveyance gaps, where the system lacks conveyance infrastructure. This section seeks to clearly itemize the problems and recommend solutions and implementation pathways.

Note that in many cases, solving conveyance gap problems will help solve capacity risks – often pipes are overloaded because they're carrying flow for multiple surrounding blocks, and a more distributed system will help relieve the problem.

SPU-led capital improvements are currently in design and expected to be constructed by 2027. Because the other strategies summarized in these tables depend on action by others, their timing will be dependent on the schedules of future projects, as well as successful code implementation and partnerships.

Table 3.6.1 **Recommendations for addressing capacity risk areas (see Figure 2.4.D)**

Problem area	Implementation pathway	Sequencing notes
A – Street flooding on the 17th Ave NW Neighborhood Greenway	SPU-led capital project Upstream "Beyond Code" partnerships* and/or parcel retrofits Private development reducing peak flows by meeting code requirements	• SPU currently in Design phase for improvements and green stormwater infrastructure for 17th Ave NW • Current and future "Beyond Code" partnerships and retrofits in the upstream basin will further decrease reduce volume and peak flow.
B – Sewer backups south of NW 85th St	(Same pathways as for A) Reduce infiltration & inflow of stormwater into sewers through redevelopment, voluntary retrofits Add backflow preventers for affected side sewers	• The planned capital project and partnerships for Area A will reduce total volume, reduce peak flow, and route more flows north away from the combined sewer basin, reducing this capacity risk • If sewer risks are not substantially decreased by upstream capital improvements, additional steps may be needed (I&I prevention, backflow preventers)
C1 – flooding in closed contour area, NW Crown Hill	SPU-led capital project Infill development system extensions, and/or local improvement district	• SPU's capital project on 17th expanded its scope to pick up flows from 18th Ave NW. While not a complete solution, it will reduce the frequency, volume, and duration of flooding (C1), and may reduce pressure on the sewer (C2). • If flooding continues after that project is complete, see Section 3.2 for other alternatives to improve conveyance out of this area.
C2 – sewer capacity risk and access challenge in closed contour area, NW Crown Hill	SPU monitor SDOT's projects for opportunities to redirect sewer flows away from this area. Infill development system extension, and/or local improvement district SPU-led capital project	• Implementation would be best achieved during an SDOT project to repave NW 85th St., and/or during sewer rehab of the pipes in question. • Upsizing pipes in constricted areas to the northwest would help reduce the capacity risk here (Figure 3.4.A) • If other improvements don't reduce the risk in this area, in the future SPU may consider routing flows from north/south streets in this sewer catchments straight south across 85th into combined sewer mains. See discussion in Section 3.4.
D – modeled sewer capacity risk areas.	Infill development, future capital projects Reduce infiltration & inflow of stormwater into the sewer pipes	• No sewer claims or observed SSOs in these modeled risk areas indicate a current acute problem, but larger developments tying into these mainlines may need to evaluate whether extra mitigation is needed for their projects. • When street projects happen in downstream right-of-way, and/or pipes are due for sewer rehab, evaluate potential for upsizing pipes. See Section 3.4 for discussion of specific flow constriction areas.

NOTE: "Beyond Code" development partnerships for projects on eligible parcels upstream of any identified capacity problems would likely be helpful (SPU, 2023).

Capital project for 17th and 18th Aves NW

In parallel with development of this focus area plan, SPU developed a concept design for a capital project to address system risks on 17th Ave NW and 18th Ave NW. Options Analysis included extensive system modeling and community engagement, leading to a preferred alternative that mixes green and gray infrastructure. The project will:

- Decrease frequency, volume, and duration of flooding on 17th (Figure 2.4.D, Area A), using bioretention, deep infiltration (UICs), and new conveyance pipes.
- Reduce risk of sewer backups on 17th Ave NW south of NW 85th St (Area B, Figure 2.4.D) by decreasing overall volume in the system, and by preferentially sending more water north from the flow split at NW 87th St.
- Prevent flooding from the street to private property on 18th Ave NW by extending a drainage main into that closed contour area (Area C, Figure 2.4.D).

Due to 17th Ave NW's importance for pedestrian and bicycle mobility as a neighborhood greenway, SPU involved SDOT and greenway users in the concept design. The project will enhance the greenway by further calming traffic, and providing dedicated pedstrian facilities.

The preferred alternative (Figure 3.5.4) will move forward to design in 2024, with construction likely in 2026. For more information, see project documents at: www.tinyurl.com/SPUcrownhill

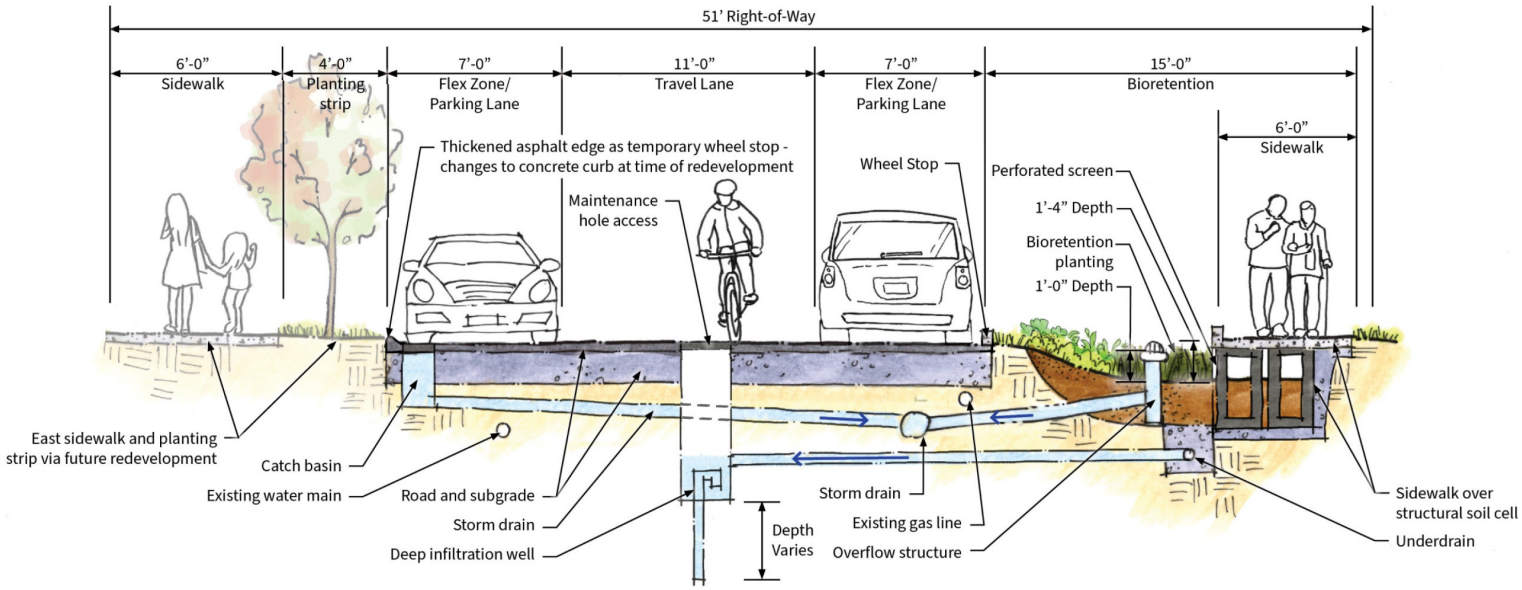


Figure 3.5.4 **Preferred alternative for 17th Ave NW.** This cross section shows part of the improvements in SPU's planned capital project at 17th Ave NW and NW 87th Street. Bioretention on the west side of street infiltrates runoff from the large upstream catchment, and an underdrain sends flow to UIC for deep infiltration.

Table 3.6.2 **Recommendations for conveyance gap areas (see Figure 3.1.A)**

Gap Area	Relative priority	Implementation pathway	Time scale	Notes
1	*LOWER*	Infill development, smaller residential projects*	Longer (15+ years)	• When these blocks eventually redevelop, it's worth considering a potential flow reroute to NW 90th St (see Figure 3.2.2B)
2	*LOWER*	Infill development, smaller residential projects	Longer (15+ years)	• With the recent storm drain extension and bioretention improvements on NW 92nd St, it may be feasible to use curb flow for the remaining redevelopment.
3	*HIGH*	Infill development, smaller residential projects	Longer (15+ years)	• The SPU capital project on 17th can likely reroute some street flows to keep them out of this depression • The remaining local drainage issue will need to be resolved through redevelopment or a local improvement district. • SPU continue to evaluate priority of city-led conveyance projects relative to other flooding issues citywide.
4	*LOWER*	Infill development, smaller residential projects	Longer (15+ years)	• Curb flow on 18th from 87th down to 85th appears feasible.
5	*HIGHER*	City-led capital project	Imminent (~3 years)	• SPU is currently in Options Analysis to design a solution to the flooding and sewer risks and conveyance needs here. See Options Analysis Report for analysis and preferred alternative. • May be a good candidate for a city-funded latecomer agreement. • Improvements should support the community's Neighborhood Greenway priorities for this street.
6	*MED*	Infill development, mixed-use & multifamily residential	Near term (~10 years)	• Existing properties that drain to 87th are good candidates for retrofit incentives • Future projects that will drain to 87th are good candidates for "beyond code" voluntary stormwater partnerships. • SPU continue to evaluate priority of city-led conveyance projects relative to other flooding issues citywide.
7	*MED*	Infill development, mixed-use & multifamily residential	Near term (~10 years)	• Existing properties that drain to 87th are good candidates for retrofit incentives, or for "beyond code" voluntary stormwater partnerships when they redevelop. • To align with community interest in Mary Ave Pedestrian Boulevard, pursue GSI streetscape concept plan with SDOT for Streets Illustrated update.
8	*LOWER*	Infill development, smaller residential projects	Longer (15+ years)	• The existing culvert system appears to have capacity to carry local flows. Redevelopment should confirm through Ensure Sufficient Capacity analysis.
9	*MED*	Infill development, mixed-use & multifamily residential	Near term (~10 years)	• Curb flow may be appropriate to connect to the existing storm drains to north and south. • SPU continue to evaluate priority of city-led conveyance projects relative to other flooding issues citywide.
10	*LOWER*	Infill development, smaller residential projects	Longer (15+ years)	• Curb flow and/or storm drain extensions to the south via King County combined sewer mains.

***NOTE:** Assessment of likely development types in this table are based on zoning. Areas zoned Residential Small Lot may redevelop as single parcels, which are unlikely to trigger stormwater conveyance extensions; but they may also experience larger scale redevelopment, which would be more likely to trigger extensions. Redevelopment of the denser zones (Lowrise Multifamily Residential or Neighborhood Commercial) in the core of the neighborhood are more consistently likely to trigger extensions.

4.0 Next steps: Actions to support the plan's recommendations

The success or failure of recommendations in this plan will depend on actions carried out by a variety of actors. This table summarizes necessary steps for SPU capital investments, future policy work, partnering outreach, internal stakeholder engagement, interdepartmental efforts, and regulating growth.

While SPU's investments in upgrading and maintaining infrastructure in this neighborhood will significantly improve system function and resilience, building out a full system like the one described in this document will depend on incremental improvements through development over time.

Table 4.0.1 **Next steps toward implementation.**

Task	Responsible parties	Timeline	Notes
"Inreach" to City of Seattle Stakeholders			
Work with SPU's Development Services Office, SDOT Street Use, and SDCI's Drainage Review desk to share findings and recommendations of this plan - including recording to GIS layers as appropriate.	DWW CPR, Planning	2025	Get feedback on scope, process, and organization for future Stormwater & Sewer Plans
System improvements by the City			
Design and construct preferred alternative for reducing flood risks on 17th Ave NW and 18th Ave NW, in partnership with SDOT's Healthy Streets program (See Section 3.6)	DWW CPM, PDEB ETSD and PMD, consultants	2022-2027	See Options Analysis Report for more information
Analyze condition and long-term capacity of the drainage culvert on 14th Ave NW. Can new development continue to connect, or is a PSD extension needed? (Section 3.2)	Drainage Rehab	TBD	CCTV, modeling updates would inform need to replace
Decisions about downstream partnering opportunities to reduce sewer capacity risks – as SDOT and others work on projects in the areas with apparent flow constrictions. (See Section 3.4)	SPU/SDOT Coordination, DWW PPM sewer capacity program	TBD	Assign specific roles to make sure we catch these in early design. Identify modeling support for mini-Options Analysis
Policy work			
Law analysis - is 17th Ave project eligible for a latecomer agreement? It's not a system gap, but an undersized system that needs improvements to prevent flooding.	DWW CPR, CPM, Law	2025	Coordinate between capital project team and CPR.

Change code to formally allow municipal latecomer agreements, increase staffing as needed to implement and finalize procedures. (Review and adoption process, tracking and directing payments)	DWW CPR, PDEB DSO	2025	Ordinance drafted Nov '24, to be implemented in 2025. Gap: methodology and costs for different types of facilities.
Research and policy amendments as needed to encourage curb and gutter conveyance where preferable, in Crown Hill and other applicable areas. (Section 3.3)	DWW CPR, PDEB DSO	TBD	Build analysis off of 2024 OCI technical memo
Develop a standard plan for conveyance swales, with buy-in from stakeholders at SDOT, SPU DWW System Maintenance, and DWW System Management. Develop clearer/consistent guidance for how to assign different conveyance types to different block conditions.	DWW CPM, CPR, DSO	TBD	CPM leading current work assignment
Establish clearer expectations and best practices for Ensure Sufficient Capacity requirements to streamline the process for SPU/SDOT capital projects while protecting downstream systems.	DWW CPR, PDEB ETSD and DSO	TBD	
Summarize existing state and local rules about Local Improvement Districts; including how they work, and which drainage and wastewater projects may be good candidates.	DWW CPR	TBD	CPR to write summary memo to help planning and interested community groups.
"Beyond code" development incentives			
Rolling out expanded "beyond code" partnership tools: partnership concept, eligibility map, cost basis. Inreach to City partners and outreach to development community including affordable housing providers.	DWW CPM	2025	New CPR hire will steward the "Beyond Code" program for developers, including new tools, supporting policies.
Provide information to SDCI and OPCD to follow up on Crown Hill Neighborhood Design Guidelines' references to GSI: targeting development incentives in the highest priority parts of the neighborhood.	DWW CPR, SDCI, OPCD	TBD	Focus on downslope corner lots north of N 85th St, and/or large parcels. Part of "Beyond Code" outreach.
Site retrofits			
Work with Rain City Partnerships to explore retrofit potential at Crown Hill Center and Crown Hill Park.	DWW Code and Policy Mgmt	TBD	
SDOT planning coordination			
SDOT coordination on streetscape concept plan for Mary Ave (incorporate in Streets Illustrated update)	DWW PPM	2025	Reach out to SDOT planning team for coordination
As SPU advances use of municipal latecomer agreements, coordinate with SDOT to partner on sidewalk latecomer agreements.	DWW CPR, SDOT Planning	TBD	Include in discussion of capital partnering for these informal areas
Get detailed GSI typologies into Streets Illustrated to give clearer guidance to design teams, reduce need for Deviation review processes	DWW CPM, SDOT Planning	TBD	

Acronyms

CPM - Capital Portfolio Management workgroup (SPU)

CPR - Code, Policy, & Regulatory workgroup (SPU)

DSO - Development Services Office (SPU)

DWW - Drainage & Wastewater line of business (SPU)

ETSD - Engineering, Technical Services Division (SPU)

GSI - Green stormwater infrastructure

OPCD - Seattle Office of Planning & Community Development

PDEB - Project Delivery & Engineering Branch (SPU)

PMD - Project Management Division (SPU)

PPM - Planning & Program Management division (SPU)

SDCI - Seattle Dept of Construction and Inspections

SDOT - Seattle Dept. of Transportation

SPR - Seattle Parks & Recreation

SPU - Seattle Public Utilities

UIC - Underground injection control (deep infiltration well)

WTD - King Co. Wastewater Treatment Division

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Seattle Public Utilities

SPU provides essential water, drainage, sewer, garbage, recycling, and food and yard waste services.

www.tinyurl.com/SPUcrownhill