



KING COUNTY

1200 King County Courthouse
516 Third Avenue
Seattle, WA 98104

Signature Report

December 13, 2016

Motion 14776

Proposed No. 2016-0471.1

Sponsors Dembowski

1 A MOTION accepting a report on incentivizing use of low
2 impact development techniques prepared in accordance
3 with Ordinance 18257, Section 25.

4 WHEREAS, low impact development is a stormwater management strategy that
5 emphasizes conservation and use of existing natural site features integrated with
6 distributed, small-scale stormwater controls to more closely mimic natural hydrologic
7 patterns in residential, commercial and industrial settings, and

8 WHEREAS, low impact development techniques result in less stormwater runoff,
9 which helps reduce stream flow flashiness, which is a stream flow response to storms,
10 and velocities harmful to fish and helps reduce the transport of pollutants into streams
11 and other surface waters, and

12 WHEREAS, low impact development techniques help minimize the loss of
13 groundwater recharge that occurs when land is converted from forest to a developed
14 condition and is thereby important to keeping streams flowing and cool during the
15 summer and replenishing drinking water supplies, and

16 WHEREAS, in Ordinance 18257, Section 25, the council requested that the
17 executive transmit by August 31, 2016, a report that identifies and evaluates potential
18 pilot projects to implement incentivizing use of low impact development techniques,
19 including the following elements:

- 20 1. Identification of a minimum of six pilot projects that further the goals of
21 incentivizing the use of low impact development techniques; and
- 22 2. Evaluation of the pilot projects against the following criteria:
- 23 a. the policy goal the pilot project would achieve;
- 24 b. the anticipated costs of the pilot project and the expected impact on the
25 surface water management fee rates;
- 26 c. the anticipated benefits of the pilot project, including benefits to water
27 quality and to potential customers taking advantage of the pilot project;
- 28 d. identification and evaluation of measures to evaluate the effectiveness of the
29 project, if implemented; and
- 30 e. the length of time to implement the pilot project, and

31 WHEREAS, the executive has transmitted a report that addresses each of these
32 elements and satisfies the requirement;

33 NOW, THEREFORE, BE IT MOVED by the Council of King County:

34 The report from the department of natural resources and parks on incentivizing

35 the use of low impact development techniques submitted as Attachment A to this motion,
36 in accordance with Ordinance 18257, Section 25, is accepted.
37

Motion 14776 was introduced on 10/17/2016 and passed by the Metropolitan King County Council on 12/12/2016, by the following vote:

Yes: 9 - Mr. von Reichbauer, Mr. Gossett, Ms. Lambert, Mr. Dunn,
Mr. McDermott, Mr. Dembowski, Mr. Upthegrove, Ms. Kohl-Welles
and Ms. Balducci
No: 0
Excused: 0

KING COUNTY COUNCIL
KING COUNTY, WASHINGTON



J. Joseph McDermott, Chair

ATTEST:



Melani Pedroza, Acting Clerk of the Council

Attachments: A. Incentivizing Low Impact Development Techniques prepared in accordance with Ordinance 18257 Section 25

**Incentivizing Use of Low Impact Development Techniques
Prepared in accordance with Ordinance 18257, Section 25**

July, 2016



King County

Department of Natural Resources and Parks

Water and Land Resources Division

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Introduction

King County Ordinance 18257, Section 25 requires the King County Executive to transmit a report to the Council which "identifies potential pilot projects to implement incentivizing the use of low impact development techniques."

Specifically, the Ordinance requires the report to:

1. Identify a minimum of five pilot projects that further the goals of incentivizing the use of low impact development techniques; and
2. Evaluate the pilot projects against the following criteria:
 - a. The policy goal the pilot project would achieve;
 - b. The anticipated costs of the pilot project and the expected impact on the surface water management fee rates;
 - c. The anticipated benefits of the pilot project, including benefits to water quality and to potential customers taking advantage of the pilot project;
 - d. Identification and evaluation of measures to evaluate the effectiveness of the project, if implemented; and
 - e. The length of time to implement the pilot project.

Executive Summary

King County has long been a leader on integrating Low Impact Development (LID) Best Management Practices (BMP) into our stormwater regulations – we were one of the first jurisdictions in Washington to do so. According to Department of Planning and Environmental Review over the past four years, over 95 percent of new building permits integrated LID BMPs into their design – developers can use other stormwater management approaches when LID is infeasible. Furthermore, the Stormwater Ordinance (18257) and Surface Water Design Manual adopted in 2016 expanded the range of LID BMPs available to developers.

The major challenge we face in unincorporated King County with respect to expanding the prevalence of LID to manage stormwater is not with new development, but with existing development that occurred before LID was required on new developments. Installing LID BMPs on already developed sites is more expensive than including them in the original development of a site. On already developed sites, an LID BMP has to be constructed with no economies of scale that exist by incorporating them into the permitting, design and construction activities. The existing drainage system on the site needs to be altered, removed, and/or replaced, which is a cost not incurred when incorporated into new construction.

Why is retrofitting stormwater infrastructure to current code requirements, including LID important? The lack of stormwater controls in older developed areas is one of the most significant problems preventing Puget Sound recovery. Although King County has been requiring some level of stormwater control for new development since the late 1970s, the

application of water quality controls and substantially more effective flow controls did not occur until the early 1990s. Consequently, nearly all development occurring prior to 1990 has little or no flow control and no water quality control. In unincorporated King County, over two-thirds of the developed land was created prior to 1990. This amounts to about 150 square miles of land on which native forest was converted to impervious surfaces, lawn/landscape surfaces, and pasture/crop land surfaces without stormwater controls to mitigate the increased runoff and pollution generated by these surfaces.

This Proviso response addresses six different potential pilot projects on a range of parcel types, typical to unincorporated King County, and evaluates the effectiveness of existing and enhanced discounts to incentivize investments in retrofitting to LID technology. The analysis reflects that even a dramatic increase in the available discount still results in a relatively small financial benefit compared to the cost of construction on most sites. Due to the high cost of installation on already developed sites and the comparatively low Surface Water Management (SWM) fee discounts available for installing LID BMPs on a site, discounts alone may not incentivize the installation of LID BMPs on already developed sites. King County sharing costs on installation of LID BMPs could reduce the cost to the rate-payer to a point where a rate discount, in conjunction with cost-share funding, would serve as an incentive to invest in an LID retrofit.

This Proviso response also describes three approaches taken by other jurisdictions to retrofit stormwater infrastructure at a basin scale. Based on the analysis of the five pilot projects and research on other jurisdictions, the report includes the following recommendations for the 2017/2018 biennium:

- Water and Land Resources (WLR) Division staff shall work with the owners of the five pilot program parcels to evaluate at what level of cost share private property owners would be willing to undertake a stormwater retrofit project to invest in LID.
- Based on the outcome of the work with the property owners, WLR shall undertake at least two LID retrofits on Pilot Project parcels.
- Based on the information gathered through developing the projects on the Pilot Project parcels, WLR shall develop modified grant program guidelines to incentivize LID retrofits on private properties.
- King County will evaluate the potential of the three basin retrofit model described in this report, and working with the Nature Conservancy and other regional partners will develop a stormwater retrofit program with the goal of launching a basin retrofit in the 2019/2020 biennium.

Overview

To prepare this report, the Water and Land Resources (WLR) Division in the Department of Natural Resources and Parks, selected six existing developed sites in unincorporated King County and analyzed alternative LID BMPs that would be feasible on each site. The analysis included an assessment of both the cost to implement and the cost to maintain an LID BMP after implemented. The outcome was a "potential pilot project" for each site utilizing the most cost effective LID BMP feasible. The six resulting pilot projects were then evaluated against each of the required criteria. Additionally, staff researched approaches being taken by other jurisdictions nationally to undertake basin-scale stormwater retrofit programs.

To address the question of what it might take to further the goal of incentivizing use of LID BMPs, this report estimated planning level costs for implementing and maintaining a pilot project on each of the six sites and compared those costs to the currently available financial incentive and two other possible options for financial incentives. The financial incentives currently available to these sites for implementation of LID BMPs is a surface water management (SWM) fee discount (i.e., 20 percent for the four nonresidential sites and zero for the two residential sites due to it being less than 65 percent forested).

The other two financial incentives include (1) increasing the discount to the maximum currently given to any parcel (i.e., 90 percent for nonresidential parcels and 90 percent for residential parcels), and (2) increasing the discount to the same maximum plus giving the owner a grant for 50 percent of the upfront capital cost to implement the project. To compare these different financial incentives, a capital cost recovery period was calculated to show how many years it would take for the property owner to derive a financial benefit from implementing LID BMPs.

For the purposes of this report, and consistent with state regulations, the term, "low impact development (LID) best management practices (BMPs)" is used in place of "low impact development techniques." Also, for the purposes of this report, the LID BMPs evaluated are those for which there are design standards in the King County Surface Water Design Manual. The manual contains a variety of LID BMPs, each with a defined name and characteristics.

Key Findings

- The upfront capital cost to retrofit an existing developed site with LID BMPs is very high relative to the financial incentive currently available (SWM fee discount). For all the pilot projects evaluated, the capital cost recovery period exceeds the useful life of the facility.
- Evaluation of the six Pilot Projects illustrate that the existing rate credit structure does not provide enough financial benefit to parcel owners to incentivize them to invest in retrofitting their parcel with LID facilities.

- However, with a greater rate credit and/or a larger cost share by the County, projects begin to approach a point where parcel owners may have interest in undertaking a retrofit project.
- Based on the analysis, we are recommending a 2017/2018 pilot program with the five Pilot Project property owners, using a proposed new grant program, to assess at what level of participation of cost-share we can successfully incentivize investments in LID Technology.
- Based on the research on basin-wide retrofit efforts in other U.S. jurisdictions, we are recommending evaluation of the three models described in this report, and working with the Nature Conservancy and other regional partners, further developing King County's small basin retrofit program with the goal of launching a retrofit of at least one basin in the 2019/2020 biennium.

Background and History

What is LID?

Low impact development (LID) is a stormwater management strategy that emphasizes conservation and use of existing natural site features integrated with distributed, small-scale stormwater controls to more closely mimic natural hydrologic patterns in residential, commercial, and industrial settings. LID is also known as green stormwater infrastructure. It is intended to minimize runoff during rain storms through use of techniques and devices that absorb or hold the rain water at or near where it falls. There are a variety of BMPs that offer methods and designs for dispersing, infiltrating, or otherwise reducing runoff at or near the source of runoff. The photos below illustrate several types of LID BMPs.

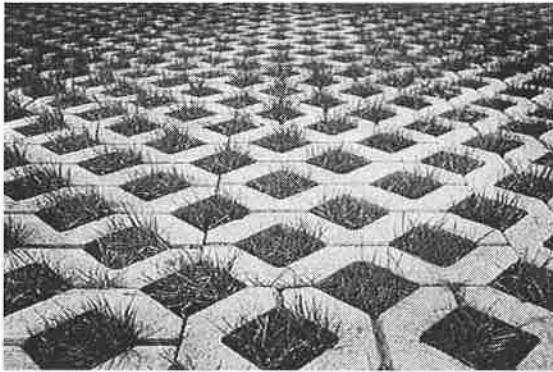
Rain Garden/Bioretention



Gravel Filled Infiltration Trench



Permeable Pavement



Rainwater Harvesting



What are the benefits of LID?

LID BMPs result in less stormwater runoff during smaller, more frequently occurring storms, which helps reduce stream flow flashiness¹ and velocities harmful to fish. Less runoff also means less transport of pollutants into streams and other surface waters during these smaller storms. For larger, less frequent storms that produce more runoff than can be controlled by LID BMPs, LID enhances the effectiveness of traditional stormwater management facilities to control this runoff and prevent severe flooding and erosion. Because LID BMPs reduce runoff largely through infiltration, they also minimize the loss of groundwater recharge that occurs when land is converted from forest to a developed condition. This is important to keeping streams flowing and cool during the summer and replenishing drinking water supplies.

What is the policy goal of LID?

The purpose of LID is to retain and infiltrate as much stormwater as feasible on development sites so as to mimic the annual runoff volume and groundwater recharge that occurred under predeveloped site conditions (typically forest). This helps protect fish habitat in streams and results in less water pollution ending up in our rivers, lakes and Puget Sound. County policies pertaining to the use of LID can be found in the 2012 King County Comprehensive Plan Chapter 4, Environment, and Chapter 8, Services, Facilities, and Utilities.

More specifically, Policies E-495, E-497, E-499I in Chapter 4 and Policies F-274, F-278, F-279, F-280, and F-281 in Chapter 8 all speak to the use of LID. Policies E-495 and E-497 call for protecting groundwater recharge through use of LID. Policy E-499I calls for promoting use of LID to maintain intact natural landscapes. Policies F-274, F-278, F-279, F-280, and F-281 all refer to the use of LID to manage stormwater runoff and protect surface waters.

¹ Stream flashiness is a stream flow response to storms. Streams that rise and fall quickly are considered flashier than those that maintain a steadier flow. An increase in flashiness, often due to changing land use, is a common cause of stream channel instability.

The Executive's proposed 2016 Comprehensive Plan makes minor text changes to several of the foregoing policies. While none of these affect the intent of any of the policies, in many cases they further emphasize the importance of investing in LID and the County's policy commitment to fostering the use of LID.

What is the history of LID implementation in King County?

King County has required the implementation of LID BMPs on new developments and redevelopments since 2005 through regulations adopted in the King County Code (KCC 9.04) and *Surface Water Design Manual (SWDM)*. Both regulations use the term "flow control BMPs," which is interchangeable with the term "LID BMPs." Developments built prior to 2005 are largely devoid of LID BMPs with the exception of roof downspout infiltration/dispersion systems required on single family residential developments since 1998; 35 percent clearing restrictions required on certain rural residential developments in the watersheds of Bear Creek, Issaquah Creek, and May Creek dating back to the 1990s; and voluntary clearing restrictions motivated by regulatory incentives in the *SWDM*.

What is the extent of LID implementation in King County?

King County's count of developed parcels with LID BMPs totals about 3,150 at this time. This is out of a total of approximately 85,120 existing developed parcels within the unincorporated area. Approximately 80,480 of these are single family residential properties and about 3,000 of them have LID BMPs. The remaining 4,630 parcels are nonresidential with approximately 150 of them having LID BMPs.

Why do we want to incentivize LID on already developed parcels?

The lack of stormwater controls in older developed areas is one of the most significant problems preventing Puget Sound recovery. Although King County has been developing and applying best available stormwater controls to new developments since the late 1970s, the application of water quality controls and substantially more effective flow controls (LID) did not occur until the early 1990s. Consequently, nearly all development occurring prior to 1990 has little or no flow control and no water quality control. In unincorporated King County, over two-thirds of the developed land was created prior to 1990.

This amounts to about 150 square miles of land on which native forest was converted to impervious surfaces, lawn/landscape surfaces, and pasture/crop land surfaces without stormwater controls to mitigate the increased runoff and pollution generated by these surfaces. To add these controls retroactively (stormwater retrofitting) will be expensive and logistically challenging. In 2012 King County began a process to identify and prioritize basins where retrofitting stormwater infrastructure would yield the best results.

This assessment identified over 60 small stream/lake basins in unincorporated King County where degradation in biological health or water quality had been documented through County or State monitoring and the degradation was likely the result of stormwater runoff from developed

land based on the extent and age of development within the basin. As a result of the 2012 assessment, the Small Basin Stormwater Retrofit Program was funded to begin developing basin-wide retrofit plans and identifying and implementing retrofit projects aimed at restoring stream health/water quality in each basin.

To date King County has begun design and planning in several of the 60 basins, Evans Creek Tributary 108, May Creek Tributary 291A, and the County is currently working on a Bear Creek Basin Plan effort that will span a number of the small basins high on the list. The County is currently partners with the City of Redmond on a grant-funded small basin retrofit planning effort for Monticello Creek. The basin for this creek is mostly within the City but includes some unincorporated area where they want to do feasibility analysis of a retrofit project.

To the extent that private property owners in these basins undertake LID retrofits on their own parcels, they will contribute to addressing the overall issue of degraded water quality and high flows in these creek basins. Consequently, it is in the County's interest to create incentives for people to invest in LID retrofits on already developed parcels.

What are the incentives for use of LID on existing developed parcels?

King County has had a program for incentivizing the use of LID BMPs on existing developed parcels since 2001. The program is made possible by the SWM fee rate adjustment provisions in KCC 9.08.080 and the direction given in KCC 9.08.120 to develop standards and procedures for SWM fee discounts and for grants to help citizens reduce impervious surface. The program has three elements as summarized below and detailed in the standards and procedures adopted by public rule in the *SWM Fee Protocols*.

Discounts: Two types of discounts are available to SWM fee rate payers who have and maintain LID BMPs and/or other County-standard stormwater controls for managing runoff from their parcel's impervious surface:

- *Stackable discounts for non-residential parcels.* The amount of discount depends on the type and level of stormwater control being provided but multiple facilities or controls can be combined (stacked) to increase the discounts:
 - An older and smaller flow control facility can qualify for up to a 20 percent discount while a larger modern flow control facility can qualify for up to a 40 percent discount.
 - A water quality treatment facility can qualify for up to a 20 percent discount.
 - Parcels with LID BMPs can qualify for up to a 20 percent discount.
 - Parcels subject to a National Pollutant Discharge Elimination System (NPDES) stormwater permit and the extra stormwater controls required by that permit can qualify for a 10 percent discount.

All these discounts are "stackable" up to a total maximum of 90 percent.

- *65-10 discount for non-residential and residential parcels.* If at least 65 percent of a parcel is preserved in a native condition (typically forest) and the runoff from its impervious surface is dispersed such that 10 percent or less of the parcel is considered impervious, then an 80

percent discount is applicable to non-residential parcels and a 50 percent discount is applicable to residential parcels.

The WLR Division currently inspects discounted parcels biennially to verify that the LID BMPs and other stormwater controls qualifying for discount are being maintained. Only 86 of these currently receive discounts for use of LID BMPs. The remaining 3,000 are single family residential properties that have LID BMPs for which there is currently not a discount offered.

Credits: For non-residential parcels, the SWM fee charged is based on the percentage of measured area covered by roofs, pavement, and other hard surfaces defined as "impervious surface" on the parcel. An "impervious surface reduction credit" is currently available to SWM fee rate payers who have and maintain one or both of the following two LID BMPs:

- "Grassed modular grid pavement" – 100 percent credit for the area covered by this type of permeable pavement if it is constructed to the standards in the *SWDM*.
- "Vegetated roof" – up to a 90 percent credit for the area covered by a vegetated roof depending on the type of soil and its depth.

The area credited is subtracted from the original measured impervious area and then used as the official area for determining the SWM fee rate. If the area credited is large enough to put the parcel into a lower rate category, the SWM fee is reduced to that lower rate. In addition, any discounts approved for the parcel are subtracted from the lower rate. The WLR Division currently inspects parcels biennially to verify that the LID BMPs and other stormwater controls qualifying for discount or credit are being maintained.

No parcel is currently receiving the credit for grassed modular pavement or vegetated roof; but, if a parcel were to get a credit, it would be inspected biennially.

Grants: To provide incentive for reduction of impervious surface runoff, a grant program is available to assist non-residential parcel owners with converting their impervious surface to one or more of the following approved surfaces as described in the *SWM Fee Protocols*:

- Compost-amended lawn
- Native vegetated landscape
- Grassed modular grid pavement that qualifies for an impervious surface reduction credit.

The grant program offers to fund 50 percent of the conversion cost up to maximum of \$20,000 per grant. The area converted can be subtracted from the original measured impervious area and then used as the area for determining the SWM fee rate. If the area converted is large enough to put the parcel into a lower rate category, the SWM fee is reduced to that lower rate. Any discounts approved for the parcel are subtracted from the lower rate. The WLR Division would inspect these parcels biennially to verify that the stormwater controls qualifying for discount or credit are being maintained. Since this grant program was created in 2001, only a handful of parcel owners have shown interest and no one has opted to apply for the funding.

Pilot Projects

Pilot Projects - Site Selection

A number of existing developed sites were evaluated to identify conceptually feasible pilot projects to evaluate against the criteria set forth in Ordinance 18257, Section 25. The six sites described below were selected based on previous property owner interest in LID or reducing their SWM fee, and identifying a good cross-section of representative development types, sizes, and impervious surface percentages across unincorporated King County to illustrate the relative costs and ability to provide financial incentive.

Vashon Grocery Store (site 1) is on Vashon Island. It is on a 2.96-acre parcel that is about 95 percent impervious, two thirds of which is pavement (mostly for parking) and the rest is building area. The site is representative of larger, highly impervious sites.

Enumclaw Restaurant (site 2) is a restaurant in the Enumclaw area. It is on a 1.37-acre parcel that is about 48 percent impervious, two thirds of which is pavement (mostly for parking) and the rest is building area. The site is representative of smaller, highly impervious sites.

Rural Private Airport (site 3) is a small private airport located near Fall City. It is on an 11.77-acre parcel that is about 15 percent impervious, all of which is the airstrip. This site is representative of large parcels that have a low percentage of impervious surfaces.

Rural Church (site 4) is in Maple Valley. It is on a 2.54-acre parcel that is about 16 percent impervious, about half of which is pavement and rest is building area. This site is included because LID could be incorporated into the design and construction of a play area that the church has expressed interest in redeveloping. The site is representative of parcels with a moderate percentage of impervious surfaces.

Typical Residential Property – Rural (site 5) Site is located east of Auburn. It is on a 0.9-acre residential parcel that is about 23 percent impervious. The site is representative of rural suburban residential parcels.

Typical Single Family Residential Property – Urban (site 6) Site is located in the White Center area. It is a 0.19 acre property that is about 38 percent impervious. The site is representative of urban residential parcels.

For more information on each selected site, see Exhibits A and B.

Pilot Projects - Best Management Practice (BMP) Selection for Each Site

On each of the six selected sites, different types of County-standard LID BMPs were analyzed to determine the most cost effective BMP that is "conceptually feasible" (i.e., feasible based on file information and a field visit as opposed to more detailed site assessment involving soils testing/analysis, field survey, and engineering analysis). The LID facilities analyzed included the following, listed in priority order according to their relative effectiveness in minimizing stormwater runoff and maximizing groundwater recharge:

- **Full Dispersion or Full Infiltration** – Full Dispersion involves preserving forest area on 65 percent or more of the site and dispersing/spreading runoff into the forest area where it is retained and infiltrated by the spongy duff on the forest floor and/or consumed by the vegetation. Full Infiltration involves infiltrating the runoff from impervious surface via gravel-filled trenches or drywells.
- **Limited Infiltration, Rain Garden (also called Bioretention), or Permeable Pavement** – Limited Infiltration is like Full Infiltration, except it may be used where Full Infiltration is not feasible due to soils with low to moderate permeability Rain Gardens are small vegetated ponds that retain and infiltrate runoff. Permeable Pavement allows stormwater to pass through the pavement into a reservoir under the pavement where it infiltrates.
- **Basic Dispersion** – Involves spreading the runoff over lawn or landscape areas so it has some opportunity to infiltrate before leaving the site.

BMPs found to be conceptually feasible on the site were analyzed for costs (both capital and annual maintenance costs). Where multiple BMPs of similar effectiveness were found to be conceptually feasible, the BMP with the lowest costs was selected as the pilot project for the site.

In general, the lowest cost BMP to retrofit into an already developed site is Full Dispersion if the site is 65 percent or more forested and less than 20 percent impervious. This is followed by Full Infiltration if the site has highly permeable soils, which is not likely on most of the land in King County. Following this is a Rain Garden if there is a suitable area on the property to place the vegetated pond and soils are moderately permeable. Limited Infiltration is the next cheapest BMP to retrofit, and Permeable Pavement is by far the most expensive (more than double the cost of the other BMPs on average).

Hence, the pilot project selected for each site is the most cost effective and conceptually feasible project. Note that the costs in this report are planning level estimates for the purposes of comparing alternative BMPs and exploring the financial implications of implementing and maintaining LID BMPs on each site. Actual costs will vary from these depending on whether there are soils or other site conditions that differ from those assumed based on best available parcel information and limited field observations.

Pilot Projects - Evaluation and Discussion

Each of the Pilot Project sites/facilities was evaluated against criteria specified at the beginning of this report. In all cases the policy goals achieved were the same for all facilities. Installing any of the LID facilities studies in this report will support policy E-495 of the King County Comprehensive Plan by increasing infiltration of runoff on the site. The anticipated environmental benefits, including benefits to water quality and to property owners implementing such a project, are also relatively consistent across projects, with some variation between sites. Generally, LID facilities help increase stormwater infiltration, recharge the local groundwater, and provide additional summer flow in local streams.

The primary area where there is variability between the pilot projects is in the cost of the facilities, the potential rate discount available to the property owner, and the cost recovery period for the facilities based on the SWM fee discount. The Table below provides an overview of the project costs, the SWM fee discount realized under the current discount structure, the discount under a 90 percent discount, and with a 50 percent cost share.

Pilot Project Incentive Evaluation Table

Pilot Project	Capital Cost ¹	Annual Maint. Cost ¹	Current SWM Fee and Available SWM Fee Discount	Cost Recovery Period ² under Current Available Discount	Cost Recovery Period for Increased Discount ³	Cost Recovery Period for Increased Discount + 50% Grant ⁴
Vashon Grocery Store Site – Install 1830 linear feet of "Limited Infiltration" trench	\$191,800	\$250	\$7811 \$1562	147 yrs.	29 yrs.	15 yrs.
Enumclaw Restaurant Site – Install a 2280 square foot "Rain Garden"	\$21,200	\$200	\$1241 \$248	440 yrs.	13 yrs.	7 yrs.
Rural Private Airport Site – Install 800 linear feet of "Full Infiltration" trench	\$86,500	\$250	\$4865 \$973	120 yrs.	21 yrs.	11 yrs.
Rural Church site – Install 268 linear feet of "Limited Infiltration" trench	\$35,400	\$250	\$1050 \$210	Not Recovered	51 yrs.	26 yrs.
Typical S.F. Residential - Rural – Install 91 linear feet of "Full Infiltration" trench	\$14,600	\$250	\$171.50 \$0	Not Recovered	Not Recovered	Not Recovered
Typical S.F. Residential – Urban – Install 110 linear feet of "Limited Infiltration" trench	\$17,500	\$250	\$171.50 \$0	Not Recovered	Not Recovered	Not Recovered

¹ Planning level cost estimates

² Capital Cost / (Annual SWM Fee discount – Annual Maintenance Cost)

³ Assumes a 90 percent discount.

⁴ Assumes the County provides a grant for 50% of the capital cost in addition to the above discount.

The table reflects that the upfront capital cost to retrofit an existing developed site with LID BMPs is very high relative to the financial incentive currently available (SWM fee discount). For all the pilot projects evaluated, the capital cost recovery period exceeds the useful life of the facility.

Additionally, if the SWM fee discount were increased to the maximum currently given to any property owner (90 percent), the recovery period is still too long to be much of a financial incentive to the property owner. Discounts of this size are currently given to properties that provide much greater control of stormwater runoff than would be achieved by just LID BMPs. Because discounts are given based on the amount of system benefit derived from the added stormwater management capacity created by the facility, such a discount may not be equitable to other rate-payers.

If the 90 percent above was combined with the County paying 50 percent of the owner's capital cost through a grant, the recovery period begins to approach a point at which it may serve as a financial incentive to a property owner. As discussed in the background section of this report, in 2001 the County established a grant program that funds 50 percent of the conversion cost of impervious surface up to maximum of \$20,000 per grant. The area converted can be subtracted from the original measured impervious area and then used as the area for determining the SWM fee rate.

Since this grant program was created only a handful of parcel owners have shown interest and no one has opted to apply for the funding. Based on conversations with property owners of the pilot project parcels, and property owners who inquired about the existing cost share program, WLR staff believe that a higher grant cap and a greater degree of cost share would spur more interest in an expanded grant program.

Consequently, we are recommending a 2017/2018 pilot program focusing on the five Pilot Project parcels to assess at what level of participation of cost-share we can successfully incentivize investments in LID Technology. The proposed 2017/2018 SWM fee proposal and budget includes \$250,000 in new funding for a grant program to fund cost share for facility retrofits, as well as other community projects. Using these funds, Water and Land Resources will work with the five Pilot Project property owners, and other interested property owners, to determine at what funding level they would be willing to undertake a retrofit project.

Based on conversations with the property owners, we know that at least two of these properties have an interest in undertaking a retrofit project – the Vashon grocery store and the Maple Valley church. With the proposed enhanced grant funding potentially available in the next biennium, WLR staff will work with these property owners, and other interested property owners to evaluate a retrofit project. The intent of the pilot will be to complete at least two and potentially more retrofit projects within the biennium, and to develop new grant program, including

eligibility criteria, cost-share levels, a maximum cap on funding, and application/communications materials.

The workplan for developing this program, depending on approval of the SWM fee and budget, would commence in January of 2017, and outlined below:

- Develop grant program development scope/workplan (Q1 2017)
- Outreach to Pilot Project parcel owners (Q1/Q2 2017)
- Identify committed retrofit pilot project property owners and obtain project commitments (Q3/Q4 2017)
- Develop more detailed design and cost estimates for pilot projects (Q4 2017/Q1 2018)
- Project review and consultation with property owners (Q1 2018)
- Final Pilot Project designs, commitments, cost estimates, and cost share agreements (Q2 2018)
- Evaluate lessons learned from Pilot Project development (Q2/Q3 2018)
- Finalize Grant Program final eligibility criteria, application process, funding cap, and 2019/2029 budget recommendation (Q3 2018)
- Develop 2018 Grant Program budget proposal (Q3 2018)
- Pending Council approval launch revised grant program (Q1 2019)

Other Models to Achieve Basin-Wide Stormwater Retrofits with LID

The analysis of the pilot projects in this report illustrate the challenges of motivating private property owners to undertake the significant investment in retrofitting existing outdated stormwater infrastructure. Given the County's ambitious goals to undertake basin-wide stormwater retrofits, it will be necessary to adopt approaches that are not dependent entirely on individual actions, but are driven by the County and other jurisdictions in the County. Consequently, as an added element to this report WLR Division staff researched three models currently being piloted by other jurisdictions nationally, that are intended to achieve basin-wide stormwater retrofits. These three programs are outlined below, but WLR staff believe that there are elements in all of these approaches that could be adopted by King County to advance a basin-retrofit program.

City of Seattle – RainWise Program. The City of Seattle, in order to meet NPDES permit requirements for the reduction of Combined Sewer Overflows, has undertaken a program to manage 700 million gallons of polluted stormwater runoff through LID investments on private property. The program covers up to 100 percent of costs for private property owners to invest in some LID technology (rain gardens and cisterns). The property owners choose a contractor from a list of Seattle Public Utility (SPU) approved contractors and SPU reimburses the property

owners for construction of the rain garden or cistern (typical rebates average \$4,000). Approximately 1,000 homes have participated in the program thus far.

Because of King County shared interest in reducing CSOs, the DNRP has partnered with the City of Seattle on the Rainwise program – providing financial and stormwater staff support to inspect facilities and provide community outreach. This is a model that could be evaluated for expansion into unincorporated King County, with the goal of reducing stormwater runoff.

Stormwater Credit Trading Program – Washington D.C. Washington DC has undertaken a new and innovative approach to managing stormwater, that allows developers in locations where meeting the District’s stormwater code to be able to buy stormwater credits in order to construct facilities that do not meet all treatment parameters. Under D.C.’s planned regulatory framework, a regulated project would have to retain onsite at least 50 percent of the volume associated with its applicable retention standard, but they would be able to buy offsite credits to manage the rest of their runoff and those credits would be applied in areas of the District that are well suited to low impact development (LID) technology.

The offsite retention options would be either to pay the District an in-lieu fee or use a privately generated (and tradable) stormwater retention credit (SRC). This general approach could be used in King County, and might best be developed in collaboration with a subset of cities within the County – the County’s Transferable Development Right program provides a good model for how this could be done. Developers in downtown Seattle face the most challenges in meeting increasingly stringent stormwater codes, and suburban communities in north and south King County have the type of undeveloped rights-of-way (i.e. ditches/culverts) that are well suited to stormwater retrofits.

A similar model is currently being explored here in Washington State. On March 1, 2016, the Washington state Department of Commerce, in consultation with a work group of interested parties, issued a draft Building Cities in the Rain guidance that describes a process for prioritizing watersheds for stormwater retrofits. It is intended to provide a tool for local governments to target investment in stormwater retrofits in a way that leverages opportunities for salmonid habitat restoration and facilitates redevelopment in urban centers. The City of Redmond is one of the first jurisdictions to undertake a watershed prioritization process, intended to prioritize areas of the city for stormwater retrofits.

https://www.ezview.wa.gov/site/alias_1780/library_watershed_prioritization_guidance/36739/watershed_prioritization_guidance.aspx

Stormwater Infrastructure Design, Build, Operate, Maintain Model – Prince George’s County, MD. To meet its obligations under the Chesapeake Bay Total Maximum Daily Load, Prince George’s County has committed to retrofit about 8,000 acres of existing impervious surfaces at an estimated cost of \$1.2 billion. To fund these projects, the county has established an innovative public-private partnership (P3) pilot program.

As a pilot program, Prince Georges County has selected Corvias Solutions, a privately-held company, to retrofit 2,000 acres of impervious surfaces in the public right of way under a Design, Build, Operate, Maintain (DBOM) contract with Prince George's County. Under the terms of the 30-year partnership, the County will invest \$100 million in the initial three-year retrofit and Corvias will manage the design, construction and long-term maintenance of stormwater management systems for up to 4,000 acres. As an added requirement, the program will also drive local economic development by using local small and minority-owned businesses for at least 35 percent of the total project scope.

A model such as this could be implemented in King County in tandem with some form of a stormwater credit trading system or alternatively with a new funding source or simply as a stand-alone contract using a dedicated stream of revenue from the SWM fee. The benefits of a DBOM contract is that the contractor has an incentive to design cost effective and durable capital projects, because they will be managing them over time. Additionally, DBOM projects are most effectively used to construct durable/functional public infrastructure where the aesthetics of design are not an issue.

Public-Private partnership relationships pose challenges with respect to accountability for regulatory compliance, and it is necessary to integrate monitoring and adaptive management requirements into contracts. Additionally, P3 partnerships can be perceived as undermining the authority of public sector unions, and engaging appropriate labor leadership would be critical to successfully pursuing such an option.

Conclusion/Recommendations

Currently King County along with many other jurisdictions in the Puget Sound region are working with the Nature Conservancy on “Solving Stormwater” - a collaborative effort to examine ways to make a regional investment in clearing up Puget Sound (<http://www.washingtonnature.org/cities/stormwater/green-infrastructure-infographic/>). We are recommending that in the 2017/2018 biennium that the WLR division undertake an effort to evaluate the programs described in this report, and any other relevant programs, and develop recommendations to the Executive and the Council on an approach to undertaking basin-wide retrofits in unincorporated King County. Specific elements of that approach shall include, at a minimum the following actions:

- WLR Division staff shall work with the owners of the five pilot program parcels to evaluate at what level of cost share private property owners would be willing to undertake a stormwater retrofit project to invest in LID.
- Based on the outcome of the work with the property owners, WLR will pursue at least two LID retrofits on Pilot Project parcels.

- Based on the information gathered through developing the projects on the Pilot Project parcels, WLR shall develop modified grant program guidelines to incentivize LID retrofits on private properties.
- King County will evaluate the potential of the three basin retrofit model described in this report, and working with the Nature Conservancy and other regional partners will develop a stormwater retrofit program with the goal of launching at least one basin retrofit in the 2019/2020 biennium.

Exhibits

A. Pilot Project Evaluation

B. Pilot Project Site Description and Write-Ups

Exhibit A

Pilot Project Evaluation Against Specified Criteria

Below is a description and evaluation of each pilot project against the criteria specified at the beginning of this report.

Site 1 – Vashon Grocery Store – Limited Infiltration BMP

Install 1830 linear feet of gravel-filled trench to retain and infiltrate runoff from 50 percent² of the site's impervious surface for smaller, more frequent storms. The current SWM fee is \$7,811/year

- Policy goal achieved: Installing Limited Infiltration on this site would support policy E-495 of the King County Comprehensive Plan by increasing infiltration of runoff on this site. Increased infiltration on this site will recharge the local groundwater and provide additional summer flow in local streams.
- Estimated capital cost to implement the project: \$191,800, and there may be additional costs for a sand filter layer in the bottom of the infiltration trenches if the underlying site soils do not provide for adequate treatment of polluted runoff from the parking lot prior to infiltration.
- Estimated annual maintenance cost: \$250 for cleaning the system's catch basins and pipe components on a regular basis.
- Estimated annual SWM fee savings: Limited Infiltration that serves 50 percent or more of the impervious surface on the site would qualify for a 20 percent discount and would drop the SWM fee by \$1,562/year. After subtracting the cost of annual maintenance from the annual discount, the estimated time to recover the upfront capital costs under the current SWM fee rate structure and discount code is 147 years. If the SWM fee discount were increased to the maximum given to any nonresidential parcel (i.e., 90 percent), the SWM fee would be \$781.13, and the recovery period would be 29 years. If King County were to provide a 50 percent cost share (\$95,900) in addition to this discount, the recovery period would be 15 years.
- Anticipated benefits, including benefits to water quality and to property owners implementing such a project: This site lies in the headwaters of Shinglemill Creek. Limited Infiltration on the site would help reduce the flashiness and velocities of flows in Shinglemill Creek, which is beneficial to fish use. It would also help replenish groundwater, which is important to fish use, as well as drinking water supplies on Vashon Island. The property owner would benefit from a reduced SWM fee but would incur additional maintenance costs for the BMP.
- Measures of effectiveness, if implemented: Limited Infiltration would be considered effective if little or no surface flow is observed leaving the gravel-filled trenches during smaller, more frequent storms.
- Length of time to implement: The estimated construction time for implementing Limited Infiltration on this site is 1-2 weeks. The amount of asphalt that would have to be removed and replaced to install Limited Infiltration in the parking lot would require a grading permit, which would add to the time and cost to complete this project.

² Note that 50 percent is the minimum needed to receive the maximum discount allowed for the parcel.

Site 2 – Enumclaw Restaurant – Rain Garden BMP

Install a 2280 square-foot Rain Garden to retain and infiltrate runoff from 50 percent of the site's impervious surface for smaller, more frequent storms. The current SWM fee is \$1,241/year.

- Policy goal achieved: Installing a Rain Garden on this site would support policy E-495 of the King County Comprehensive Plan by increasing infiltration of runoff on this site. Increased infiltration on this site will recharge the local groundwater and provide addition summer flow in local streams.
- Estimated capital cost to implement the project: \$21,200
- Estimated annual maintenance cost: \$200 for landscape maintenance of the Rain Garden's plants and cleaning of its structural components.
- Estimated annual SWM fee savings: A Rain Garden that serves 50 percent or more of the impervious surface on the site would qualify for a 20 percent discount and would drop the SWM fee by \$248.22/year. The annual discount, the estimated time to recover the upfront capital costs under the current SWM fee rate structure and discount code is 440 years. If the SWM fee discount were increased to the maximum given to any nonresidential parcel (i.e., 90 percent), the discount would be \$1,911.99, and the recovery period would be 13 years. If King County were to provide a 50 percent cost share (\$10,600) in addition to this discount, the recovery period would be 7 years.
- Anticipated benefits, including benefits to water quality and to property owners implementing such a project: This site lies in the headwaters of Carey Creek. Limited Infiltration on the site would help reduce the flashiness and velocities of flows in Carey Creek, which is beneficial to fish use, and would also help replenish groundwater, which is important to water quality as well as drinking water supplies. However, we do have a record of one downstream complaint about a high groundwater table which could be exacerbated by putting more water into the ground. The property owner would benefit from a reduced SWM fee but would incur additional maintenance costs for the BMP.
- Measures of effectiveness, if implemented: A Rain Garden would be considered effective on this site if little or no surface flow is observed leaving the Rain Garden during smaller, more frequent storms.
- Length of time to implement: The estimated construction time for building a Rain Garden on this site is about 2-4 days.

Site 3 – Rural Private Airport – Full Infiltration BMP

Install 800 linear feet of gravel-filled trench to infiltrate most if not all of the runoff from 50 percent of the site's impervious surface. The current SWM fee is \$4,865

- Policy goal achieved: Installing Full Infiltration on this site would support policy E-495 of the King County Comprehensive Plan by increasing infiltration of runoff on this site. Increased infiltration on this site will recharge the local groundwater and provide addition summer flow in local streams.
- Estimated capital cost to implement the project: \$86,500, and there may be additional costs for a sand filter layer in the bottom of the infiltration trenches if the underlying site soils do not provide for adequate treatment of polluted runoff from the airstrip prior to infiltration.
- Estimated annual maintenance cost: \$250 for cleaning the system's catch basins and pipe components on a regular basis.
- Estimated annual SWM fee savings: Full Infiltration that serves 50 percent or more of the impervious surface on the site would qualify for a 20 percent discount and would drop the

SWM fee by \$973/year.³ The estimated time to recover the upfront capital costs under the current SWM fee rate structure and discount code is 120 years. If the SWM fee discount were increased to the maximum given to any nonresidential parcel (i.e., 90 percent), it would result in a SWM fee of \$486, and the recovery period would be 21 years. If King County were to provide a 50 percent cost share (\$43,250) in addition to this discount, the recovery period would be 11 years.

- Anticipated benefits, including benefits to water quality and to property owners implementing such a project: As with the other sites, Full Infiltration on the site would help reduce the flashiness and velocities of flows in nearby streams and help replenish groundwater. The property owner would benefit from a reduced SWM fee but would incur additional maintenance costs for the BMP.
- Measures of effectiveness, if implemented: Full Infiltration would be considered effective if little or no surface flow is observed leaving the gravel-filled trenches during most storms. Basic Dispersion of sheet flow is also feasible on this site and would take very little site alteration to achieve although it is not considered as effective as Full Infiltration.
- Length of time to implement: The estimated construction time for installing Full Infiltration on this site is about 6-8 days.

Site 4 – Rural Church – Limited Infiltration BMP

Install 268 linear feet of gravel-filled trench to retain and infiltrate runoff from 50 percent of the site's impervious surface for smaller, more frequent storms. The current SWM fee is \$1,050/year

- Policy goal achieved: Installing Limited Infiltration on this site would support policy E-495 of the King County Comprehensive Plan by increasing infiltration of runoff on this site. Increased infiltration on this site will recharge the local groundwater and provide additional summer flow in local streams.
- Estimated capital cost to implement the project: \$35,400, and there may be additional costs for a sand filter layer in the bottom of the infiltration trenches if the underlying site soils do not provide for adequate treatment of polluted runoff from the parking lot prior to infiltration.
- Estimated annual maintenance cost: \$250 for cleaning the system's catch basins and pipe components on a regular basis.
- Estimated annual SWM fee savings: Limited Infiltration that serves 50 percent or more of the impervious surface on the site would qualify for a 20 percent discount and would drop the SWM fee by \$210/year. Because the annual maintenance cost exceeds the amount of this discount, the estimated capital cost would never be recovered. If the SWM fee discount were increased to the maximum given to any nonresidential parcel (i.e., 90 percent), the discount would be \$944.99, resulting in a SWM fee of \$105.00, and the capital recovery period would be 51 years. If King County were to provide a 50 percent cost share (\$17,700) in addition to this discount, the recovery period would be 26 years.
- Anticipated benefits, including benefits to water quality and to property owners implementing such a project: As with the other sites, Limited Infiltration on the site would help reduce the flashiness and velocities of flows in nearby streams, and would also help

³ Note that the Full Infiltration BMP may perform as well as an engineered Infiltration Facility constructed to the flow control standards of the King County Surface Water Design Manual. If so, the site would qualify for an additional 40 percent discount on their SWM fee for a total of 60 percent discount. In order to receive the additional 40 percent discount, the property owner would need to hire a professional engineer to prepare a report showing that the Full Infiltration BMP performs to the same standard as an engineered infiltration facility.

replenish groundwater. The property owner would benefit from a reduced SWM fee but would incur additional maintenance costs for the BMP.

- Measures of effectiveness, if implemented: Limited Infiltration would be considered effective if little or no surface flow is observed leaving the gravel-filled trenches during smaller, more frequent storms.
- Length of time to implement: The estimated construction time for installing Limited Infiltration on this site is about 2-4 days.

Site 5 – Rural Single Family Residence – Full Infiltration BMP

Install 91 linear feet of gravel-filled trench to infiltrate most if not all of the runoff from the site's impervious surface. The current SWM fee is \$171.50/year.

- Policy goal achieved: All runoff from this site is already infiltrated by informal dispersion or in the infiltration flow control facility for this development. Installing Full Infiltration on this site would not further the policy goals.
- Estimated capital cost to implement the project: \$14,600
- Estimated annual maintenance cost: \$200 for cleaning of the system's catch basins and pipe components on a regular basis.
- Estimated annual SWM fee savings: \$0 (there is currently no discount for residential parcels that implement and maintain LID BMPs other than Full Dispersion). Therefore, there is no recovery of upfront capital costs. For discussion purposes, if the SWM fee discount were increased to the maximum given to any residential parcel (i.e., 90 percent), the discount would be \$154.35, resulting in a SWM fee of \$17.15, and there would still be no recovery of upfront capital costs due to average annual maintenance costs exceeding the discount amount. The same holds true if the County were to provide a 50 percent cost share (\$7,300).
- Anticipated benefits, including benefits to water quality and to property owners implementing such a project: Installing Full Infiltration on this site would provide little, if any, benefit to the property owner or to water quality.
- Measures of effectiveness, if implemented: Full Infiltration would be considered effective if little or no surface flow is observed leaving the gravel-filled trenches during most storms.
- Length of time to implement: The estimated construction time for installing Full Infiltration on this site is about 2-4 days.

Site 6 – Urban Single Family Residence – Limited Infiltration BMP

Install 110 linear feet of gravel-filled trench to retain and infiltrate runoff from 50 percent of the site's impervious surface for smaller, more frequent storms. The current SWM fee is \$171.50/year

- Policy goal achieved: Installing Limited Infiltration on this site would support policy E-495 of the King County Comprehensive Plan by increasing infiltration of runoff on this site. Increased infiltration on this site will recharge the local groundwater and provide additional summer flow in local streams.
- Estimated capital cost to implement the project: \$17,500
- Estimated annual maintenance cost: \$250 for cleaning of the system's catch basins and pipe components on a regular basis.
- Estimated annual SWM fee savings: \$0 (there is currently no discount for residential parcels that implement and maintain LID BMPs other than Full Dispersion). Therefore, there is no recovery of upfront capital costs. For discussion purposes, if the SWM fee discount were

increased to the maximum given to any residential parcel (i.e., 90 percent), the discount would be \$154.35, resulting in a SWM fee of \$17.15, and there would still be no recovery of upfront capital costs due to average annual maintenance costs exceeding the discount amount. The same holds true if the County were to provide a 50 percent cost share (\$8,750).

- Anticipated benefits, including benefits to water quality and to property owners implementing such a project: As with the other sites, Limited Infiltration on the site would help reduce the flashiness and velocities of flows in nearby streams, and would also help replenish groundwater. The property owner would benefit from a reduced SWM fee but would incur additional maintenance costs for the BMP.
- Measures of effectiveness, if implemented: Limited Infiltration would be considered effective if little or no surface flow is observed leaving the gravel-filled trenches during smaller, more frequent storms.
- Length of time to implement: The estimated construction time for installing Limited Infiltration on this site is about 2-4 days.

Exhibit B

Pilot Project Write-ups

Site 1 - Vashon Grocery Store

Parcel Size: 2.96 Acre	Impervious Area: 2.79 Ac	Percent Impervious: 94.6%
SWM Fee Rate Class: 7	Current SWM Fee: \$7,811.32	Discounted SWM Fee: \$6,249.06

Overview: This store is a highly impervious site. Approximately .93 acres of impervious surface is due to the building on site and 1.82 acres of impervious surface is from the parking lot and access road. The parking lot currently drains into a conveyance system that discharges water near the northwest corner of the lot. Downspouts from the building go into underground pipes that the owner assumes connects to the conveyance system on site (Photo 1). The parking lot on the east side of the building slopes from east to west towards the building. There are planter islands at the east and west end of the parking rows. The parcel to the west is undeveloped but has a berm along its east boundary that prevents water from flowing onto the parcel.

Applying Low Impact Development to over 50 percent of the impervious area on this site would qualify for a 20 percent SWM Fee discount, or \$1,562.26/year.

Low Impact Development techniques are evaluated in a specific order from more effective to less effective. Those techniques are evaluated below in order that they would be applied to the site if this were a new development:

Full and Basic Dispersion: Full or Basic dispersion is not possible on this site. There is not enough vegetated flow path to disperse flows.

Full and Limited Infiltration: This entire site is mapped as Alderwood soil which is a till soil. Full infiltration is not feasible on this site. Alderwood soil does have storage capacity above the till layer. The actual storage volume available is dependent on the original storage capacity of the soil and the level of disturbance as a result of the development of the site. If the soils on this site are still suitable, limited infiltration would be feasible.

If the required soils report showed the soils were acceptable on this site, Limited Infiltration would be technically feasible although challenging in practice. Limited infiltration, assuming sandy loam soil, would require about 14,000 square feet of infiltration surface. This could be accomplished with five trenches under the parking lot. Each trench would be 10 feet wide and 300 feet long.

The estimated cost for installing Limited Infiltration as described above is \$191,800.

Bioretention (Rain Garden): Bioretention, also known as rain gardens, would be technically feasible on this property subject to confirmation of suitable soils through a soils report. However, the footprint of a rain garden or several rain gardens would be so large on this site that it would remove approximately 50 parking spots. These spots would have to be those closest to

the building in the lower part of the parking area. Because of the impact it would have on the business and possible issues regarding required parking spaces, rain gardens big enough to receive a SWM Fee discount are not considered feasible on this site.

Porous Pavement, Permeable Pavement and Grassed Modular Pavement (Pervious Pavements): There is no advantage to Pervious Pavements over Limited Infiltration from a hydrologic standpoint and the long term maintenance costs are much higher for Pervious Pavements than Limited Infiltration. Pervious Pavements perform best in areas of low traffic so the parking lot for this site would not be an ideal location to use them. This site was deemed not feasible for Pervious Pavements.

Note: If part or all of the parking lot or access roads were converted to Grassed Modular Pavement, the surface would no longer be considered impervious. If enough impervious surface were converted, the SWM Fee for the site might drop by moving the parcel into a lower Rate Class but there would be no SWM Fee discount unless the remaining impervious surface were served by a Low Impact Development technique. To drop this property to Rate Class 6 and lower the base SWM fee to \$6,265.70, 11,950 square feet of impervious surface would need to be converted, for Rate Class 5 for a base SWM Fee of \$4,577.34, 37,750 square feet of impervious surface would need to be converted.

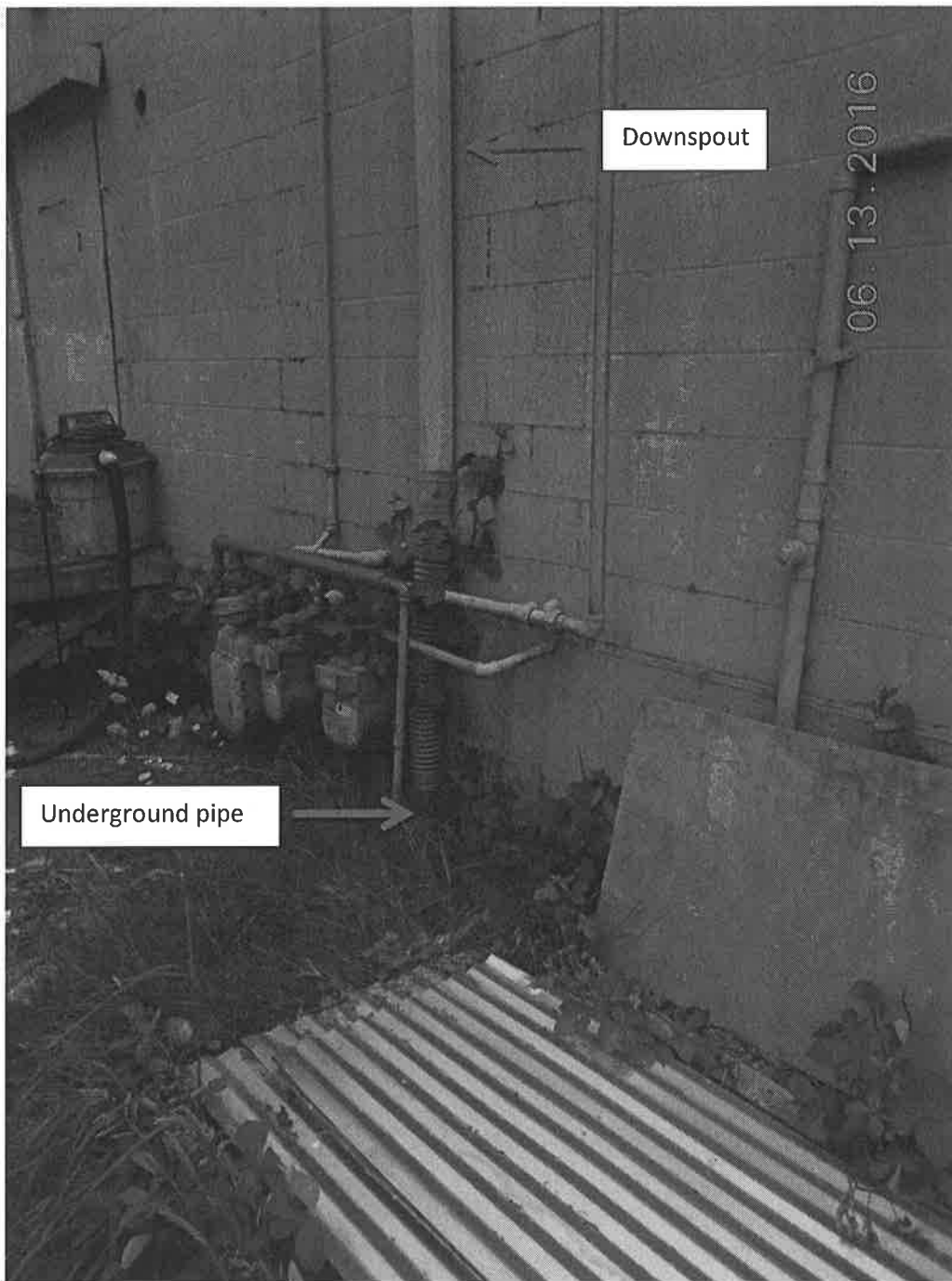


Photo 1: Downspout on west side of building going into underground pipe. All downspouts observed are directed into an underground pipe.

Site 2 - Enumclaw Restaurant

Parcel Size: 1.37 Acres	Impervious Area: .66 Acres	Percent Impervious: 48.2
SWM Fee Rate Class: 5	Current SWM Fee: \$2,118.57	Discounted SWM Fee: \$1,694.85

Overview: This restaurant is in the Enumclaw area. The property was originally developed in 1916 but has been remodeled/rebuilt since. The soils in the area are Alderwood which means there is a glacial till layer typically within 6 feet of the surface. The site is relatively flat with a general slope in the area from southwest to northeast at less than 2 percent. The septic system is built in the northwest corner which is the only large vegetated area on the property. The buildings on site generally do not have gutters.

Applying Low Impact Development to over 50 percent of the impervious area on this site would qualify for a 20 percent SWM Fee discount, or \$423.72/year.

Low Impact Development techniques are evaluated in a specific order from more effective to less effective. Those techniques are evaluated below in order that they would be applied to the site if this were a new development:

Full and Basic Dispersion: Full dispersion is not feasible on this site because the site has virtually no native vegetation on site. Basic Dispersion is also not feasible because the only vegetated flow path on the site is on the highest portion of the lot and is used for the septic drainfield.

Full and Limited Infiltration: This site is mapped entirely as Buckley Gravelly Silt Loam. Full infiltration is not feasible in this soil. Although limited infiltration appears to be feasible based on the functioning septic system on site, the length of required infiltration trench based on the mapped Buckley soil would make limited infiltration not feasible on this site. To serve half of the impervious area on this site would require nearly 2500 linear feet of 2 foot wide infiltration trench. There is not enough room on this site to construct enough infiltration trench.

Bioretention (Rain Garden): Rain gardens appear to be feasible based on the functioning septic system but would be subject to the results of a soils report. A rain garden would have to be approximately 2300 square feet and would have to be put in an area that is currently being used for parking. Just over 9 parking spaces would be replaced with the rain garden. A rain garden would not be allowed within 10 feet of the septic system so a likely location would be on the east side of the property north of the buildings.

The approximate cost for installing a bioswale on this site is \$21,200.

Note that installing a rain garden would convert 2300 square feet of impervious surface to pervious surface and would drop this parcel to Rate Class 4. The base SWM fee for the parcel would drop to \$1,241.57 and the discounted SWM fee would be \$992.88. The total SWM fee reduction on the property would be \$1,125.69/yr.

Permeable Pavement: Permeable pavement could be used for the parking areas on this site pending the results of a soils report. About 14,500 square feet of parking area would have to be converted to receive a 20 percent SWM fee discount.

The approximate cost for converting existing gravel parking area to permeable pavement is \$147,300.



Photo 1: Looking northwest at the parking area that could be used for installing a rain garden or a perforated pipe connection. The septic system is behind the white fence in the background.



Photo 2: Looking north at the buildings and west parking area. The septic system is behind the white fence in the background.

Site 3 - Rural Private Airport

Lot Size: 11.77 Acres Impervious Surface Area: 1.82 Acres Percent Impervious: 15.4
Rate Class: 3 Current SWM Fee: \$4,865.48 Discounted SWM Fee: \$3,892.39

Overview: This airport is a private airport that was built before Low Impact Development (LID) techniques were required. The parcel presents challenges to implementing LID techniques because the site is about 2800 feet long but only 180 feet wide. The impervious area is spread out over a long narrow strip on the property. The site is generally flat with the eastern 1600 feet having an average slope of 1.2 percent and the western 1200 feet having an average slope of 2.5 percent. There is a very slight slope from north to south across the parcel. The entire site is clear of tall vegetation with the areas around the runway being mainly grass. There are a variety of soils mapped on this site but generally the eastern 80 percent of the site has soils that are well draining or excessively draining and the western 20 percent of the site has soils that are poorly draining.

Dispersion: Full dispersion is likely not feasible on this site because there is no native vegetated areas on the property. Basic Dispersion is feasible on this site because only a 50 foot vegetated flow path is needed and there is about 90 feet of grass between the runway and the property line.

The runway is 25 feet wide which would require a 40 foot wide vegetated flow path if the runoff from the runway can be discharged from the runway as sheet flow. Approximated 1600 linear feet of runway needs to be dispersed to qualify for a SWM fee discount.

The cost to implement Basic Dispersion on this site would be approximately \$3,000.

Infiltration: With the well to excessively drained soils on most of this site full infiltration may be possible pending confirmation with a soils report. If full infiltration is not feasible, then limited infiltration would be feasible. The determining factor would likely be the depth to the limiting soil type which can be as shallow as 20 inches or more than 8 feet deep.

If the soils report supported full infiltration, 800 linear feet of 2 foot wide infiltration trench would be needed to serve enough area to qualify for a SWM fee discount. Runoff from the runway would have to be collected to be routed to the infiltration trench.

If full infiltration were not feasible on this parcel because the soils were not as well drained as those mapped on the site, limited infiltration would be difficult to implement on this site due to the long, narrow configuration of the impervious surface on site. Limited infiltration would require 2780 linear feet of 2 foot wide infiltration trench to qualify for a SWM fee discount. One option would be to drain short sections of runway to individual infiltration trenches staggered along the runway with each section of runway collected at the downstream end of that section and piped to an infiltration trench.

The cost to implement full infiltration on this site would be approximately \$86,500.

The cost to implement limited infiltration on this site would be approximately \$284,500.

Bioretention (Rain Garden): Rain gardens, while technically feasible, would not be a good choice for this site due to the long skinny configuration of the impervious area on site and the relatively flat grade of the impervious surface. Many small rain gardens would likely have to be constructed to serve short sections of the runway. In addition, the vegetation typically planted in a rain garden would be much taller than the current vegetation along the runway.

Permeable Pavement: Permeable pavement is not feasible on this site due to the demands related to landing a plane on the pavement. Also, since full or basic infiltration is feasible on this property and there is room outside the runway to for the infiltration trenches, it makes no sense to replace the runway to install the reservoir under the pavement.



Photo 1: Looking east at the runway and the vegetated area along the runway.



Photo 2: Looking west at the runway and vegetated strip along the runway.

Site 4 - Rural Church

Lot Size: 2.54 Acres Impervious Surface Area: 0.41 Acres Percent Impervious: 16.1
Rate Class: 21 Current SWM Fee: \$1,049.99 Discounted SWM Fee: \$839.99

Overview: This church was built in 1961 before Low Impact Development techniques were required. The soils in the area are Alderwood meaning there is a glacial till layer generally within 6 feet of the ground surface. The site slopes from northeast to southwest with an average slope of about 5 percent. Two structures sit on the eastern third of the lot with a driveway and parking area along the south side of the parcel. The southern structure has downspouts that go into underground pipes. It is not known where the underground pipes go. The northern structure does not have gutters and stormwater sheet flows off each side. The church has plans to update its play area sometime in the future which would be an opportunity to incorporate Low Impact Development techniques into the design to serve the existing impervious surface on site.

Dispersion: This site is over 90 percent clear of native vegetation so full dispersion is not feasible unless a native vegetated flow path were replanted. Basic dispersion would technically be feasible on this site as much of it is covered with grass with gentle slopes. However, much of the vegetated flow path is above the impervious area. Both buildings and some of the parking area would need to be dispersed in order to qualify for a SWM Fee discount. It is not clear if enough impervious area could be routed to a vegetated flow path on site. In addition, the property owner plans on improving their play area in the future which would likely impact the vegetated flow paths.

Basic dispersion would require 130 total feet of dispersal system with 50 feet of vegetated flow path below the system. Approximately 270 feet of potential dispersal area was identified.

If runoff from impervious surface can actually get to a dispersal area, the cost to implement basic dispersion on this site is approximately \$5,100.

Infiltration: Alderwood soils would not typically allow full infiltration but limited infiltration would likely be feasible subject to the results of a soils report. Both buildings and part of the parking area would have to be infiltrated to qualify for a SWM Fee discount. The southern building may already have infiltration systems for its downspouts. The northern building does not have gutters and would likely need to install gutters to convey runoff to an infiltration trench. The two buildings account for 7000 of the required 8950 square feet that would have to be served with Low Impact Development techniques to receive a SWM fee discount. About 1950 square feet of parking area would have to have the runoff collected and directed to an infiltration system to qualify for a SWM fee discount.

Alderwood soils typically qualify as medium sand soils if the till layer is deep enough. As such, this site would likely need 270 linear feet of infiltration trench to qualify for a SWM fee discount.

The cost to install Limited Infiltration on this site is approximately \$35,400.

Bioretention (Rain Garden): Rain gardens are likely feasible on this site subject to having adequate depth to the glacial till layer which would be determined by a soils report. There are many locations on this site where rain gardens could be constructed. The only place that would not be suitable is just north of the parking area where the large trees shade the area under them.

A rain garden would need to have a foot print of 1420 square feet and be one foot deep to qualify for a SWM fee discount.

The cost to install a rain garden on this site is approximately \$17,900.

Permeable Pavement: Permeable pavement likely could be used for the parking area on this site. Check dams under the pavement would have to be used to prevent the stormwater from flowing to the low part of the parking area.

Not all of the parking area would need to be converted to permeable pavement to qualify for a SWM fee discount but this analysis assumes all the parking area is converted to permeable pavement for aesthetic purposes. The total area of parking area to be converted to permeable pavement is about 11,000 square feet.

The cost to install permeable pavement on this site is approximately \$92,800.



Photo 1: Looking west at the parking lot for the Church.



Photo 2: Downspouts on the southern building already go into the ground but it is not known what they are connected to.



Photo 3: Looking east at the play areas for the Church. The church plans to update this area in the future.

Site 5 - Rural Single Family Residence

Lot Size: 0.90 Acres	Impervious Surface Area: 0.21* Acres	Percent Impervious: 23.0
Rate Class: 1	Current SWM Fee: \$171.50	Discounted SWM Fee:
N/A**		

*Approximate impervious area on site. Residential parcels do not require the impervious surface to be measured to calculate the SWM Fee for the parcel.

**King County Code does not grant a discount to residential parcels that implement Low Impact Development techniques to serve the impervious area on site.

Overview: This property is a residential property that was platted in 1987 before Low Impact Development techniques were required. The property is just under an acre in size. The soils in the area are Everett which have a high infiltration rate. The site slopes from west to east. The western half of the lot is relatively flat with slopes less than 10 percent. The eastern half of the property slopes down to the roadway with slopes up to 30 percent. The eastern slope has been terraced with rockeries. The downspouts for the house on this property currently discharge to the ground or the driveway.

Dispersion: Full dispersion is not feasible on this site because the site does not have vegetated flow paths that are long enough. Basic Dispersion is probably not feasible on this site either because the only vegetated flow paths with sufficient length with low enough slope are higher than the impervious areas.

Infiltration: With soils mapped as Everett on site, full infiltration should be possible subject to a more detailed soil survey. Limited infiltration would almost certainly be feasible if the soils report did not allow full infiltration. However, approval from a geotechnical engineer would likely be required to install the infiltration system near the steeper slopes on the east side of the property.

Full infiltration on this site would require 91 linear feet of 2 foot wide infiltration trench. A 91 foot trench could be placed in the lowest terrace along the east property line. If tree root intrusions were a concern on the lowest terrace, the trench could be moved up to the next terrace.

The cost for implementing full infiltration on the site is \$14,600.

Bioretention (Rain Garden): The western half of the property is up slope from the impervious area on site and is shaded by tree canopy. A rain garden would have to be sited on the eastern half of the property. A rain garden would likely have to be placed on the lower terrace along the east property line or be approved by a geotechnical engineer to be placed above the slopes on the eastern half of the property.

A rain garden on this site would have to have a footprint of 381 square feet with a one foot depth.

The cost to construct a rain garden on this site would be \$8,000.

Permeable Pavement: Permeable pavement likely could only be used for a small portion of the driveway in front of the garage and would have to have approval from a geotechnical engineer to infiltrate water at the top of the slope to the east. The rest of the driveway, the majority of area, is too steep to use permeable pavement on.



Photo 1: All downspouts discharge to the ground whether the surface is impervious like this downspout or pervious like the downspouts in Photo 2.

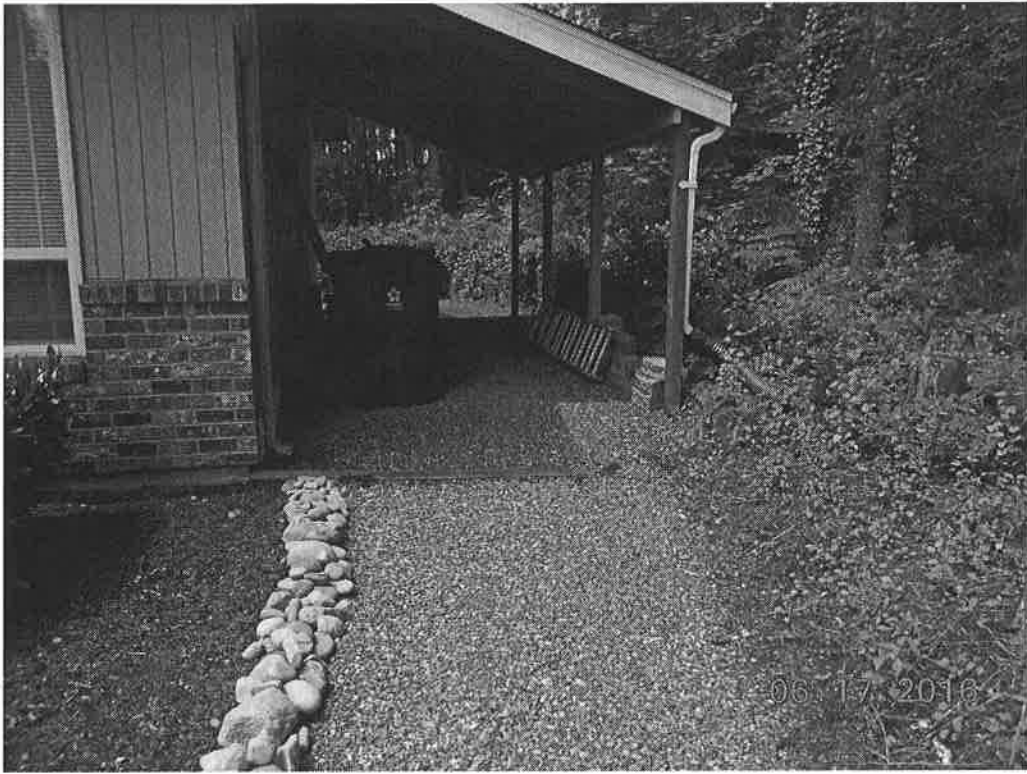


Photo 2: Downspouts discharging to pervious ground.

Site 6 - Urban Single Family Residence

Lot Size: 0.19 Acres	Impervious Surface Area: 0.04* Acres	Percent Impervious: 38.2
Rate Class: 1	Current SWM Fee: \$171.50	Discounted SWM Fee:
N/A**		

*Approximate impervious area on site. Residential parcels do not require the impervious surface to be measured to calculate the SWM Fee for the parcel.

**King County Code does not grant a discount to residential parcels that implement Low Impact Development techniques to serve the impervious area on site.

Overview: This residential property was developed in 1951 long before Low Impact Development techniques were required. The property is just over 8000 square feet in size. The soils in the area are Glacial till with pockets of Younger Gravel overlying the till. The Younger Gravel areas would have high infiltration rates whereas the Glacial Till area will have much lower infiltration rates. The site slopes from northeast to southwest with slopes generally below 5 percent except for the western property line where the slope increases up to 10 percent. The site is generally clear of native vegetation with a large portion of the lot being lawn and a few large trees along the west property line.

Dispersion: Full dispersion is not feasible on this site because the site does not have a native vegetated flow path on site. Basic Dispersion is not feasible on this site either because the only available vegetated flow paths (lawn) are not long enough.

Infiltration: With soils mapped as Glacial Till or Younger Gravels, full infiltration may be possible on this site subject to a more detailed on site soil survey. Limited infiltration would likely be feasible on this site if the soils report did not allow full infiltration as long as there is more than three feet of infiltrative soil above the Glacial Till.

Full infiltration on this site would require 31 linear feet of 2 foot wide infiltration trench. A 31 foot trench could be placed in northwest quadrant of this lot or parallel to the south property line.

If the soils did not allow Full Infiltration, Limited Infiltration would require 110 linear feet of 2 foot wide infiltration trench assuming sand/loam soils. Two 40 foot infiltration trenches could be placed in the northwest quadrant of the property and a 30 foot trench could be placed on the east third of the property.

The cost for implementing Full Infiltration on the site is \$9,600.

The cost for implementing Limited Infiltration on the site is \$17,500.

Bioretention (Rain Garden): The western half of the property is up slope from the impervious area on site and is shaded by tree canopy. A rain garden would have to be sited on the eastern half of the property. A rain garden would likely have to be placed on the lower terrace along the east property line or be approved by a geotechnical engineer to be placed above the slopes on the eastern half of the property.

A rain garden on this site would have to have a footprint of 105 square feet with a one foot depth.

The cost to construct a rain garden on this site would be \$4,600. The majority of cost on this site would be the soils report (\$3,500).

Permeable Pavement: Permeable pavement could be used to for the driveway and sidewalk for this property. However, the driveway and sidewalk only make up 27 percent of the impervious surface on this site so another LID technique would have to be used to serve another 23 percent of the impervious surface on this site.

If the driveway and sidewalk were converted to permeable pavement, approximately another 800 square feet of impervious surface could be served by limited infiltration to qualify for a SWM fee discount. Such a design would cost \$20,800 for the permeable pavement and \$3,000 for 61 linear feet of 2 foot wide infiltration trench for a total of \$23,800.



Photo 1: Looking west at the driveway and structures on a typical urban residential parcel.