



Snohomish County

South Warm Beach Master Drainage Plan

Executive Summary

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Purpose and Scope

The primary purpose of the South Warm Beach Master Drainage Plan was to gain a better understanding of the drainage systems in the South Warm Beach study area in order to identify and resolve existing surface water problems. While the approach to this study is consistent with the studies conducted for the Drainage Needs Report (DNR) project, it was not included in the original DNR project since it is not located within an existing urban growth area. Existing drainage systems were analyzed for this study to identify existing flooding problems and to predict how future development might impact these drainage systems. Additional analyses were conducted to evaluate potential improvements that would address the identified and predicted flooding problems. To conduct these analyses, an inventory of existing drainage conveyance systems was conducted and detailed hydrologic and hydraulic models were created.

A secondary purpose of this study was to evaluate aquatic habitat and fish passage conditions along two streams within the study area. While most of these analyses were based on field reconnaissance, the hydraulic model results were also used to help evaluate fish passage conditions through existing stream culverts in the study area.

Another secondary purpose of the study was to help determine whether improvements to the existing drainage systems would help to improve the function of individual septic systems in the study area. A brief summary of current water quality conditions in the study area is therefore included in this study.

Study Area

As indicated in Figure ES-1, the South Warm Beach study area is located in the unincorporated northwest portion of Snohomish County south of the City of Stanwood and west of the City of Arlington. The entire study area generally drains to the west and stormwater runoff discharges directly into Puget Sound at Port Susan.

As shown in Figure ES-1, this study area includes the Lake Martha Creek basin to the north, the Greenwood Creek basin to the south, and several neighborhood drainage systems in between. The study area was selected based on historical problems in the area and the higher density of residential development near Port Susan. However, the study area does not include the entire Warm Beach region.

Lake Martha Creek and Greenwood Creek are similar in that both streams consist of a main stem that flow year round from their relatively flat headwaters, through a steeper reach with a large ravine, and then discharge into Puget Sound. Lake Martha Creek contains two lakes: Lake Martha and Lake Howard. The original homes around the lakes and along the South Warm Beach shoreline were likely vacation homes constructed between the 1930's and 1960's. Since that time, many of these parcels have had



Figure ES-1 South Warm Beach Study Area

boundary line adjustments and then much larger primary homes have been built. However, the drainage systems have remained relatively unchanged with very few of the systems being upgraded or re-designed.

In between Lake Martha Creek and Greenwood Creek, several local drainage systems have been constructed to collect runoff from neighborhoods at the west end of the study area near Puget Sound. Most of these systems consist of roadside ditches and culverts along with some enclosed drainage pipes as well. Two of the more recent developments have installed underground detention pipes. The first one was constructed in 1995 as part of a re-plat for the Giles trail permit (T-0062) and is located at the end of 95th Avenue NW just north of 192nd Street NW. The other one was



Typical roadside ditch and culvert system in South Warm Beach residential area (Clarence Ave)

constructed in 2001 along 98th Drive NW as part of another re-plat. Even though it is outside of the UGA, portions of the South Warm Beach area continue to experience moderate development within the previously platted areas.

In addition, soil conditions in the study area appear to be responsible for creating some unusual interactions between surface water and groundwater. In some areas, groundwater was observed to be seeping out of the ground. In other areas, stormwater flowing in open channels was observed to completely infiltrate into the ground and disappear at the surface. While these conditions can be reasonably explained by the soil conditions in the area, there is still a level of uncertainty related to the interaction of surface water and ground water in the residential area draining to Puget Sound.

Flooding Issues

Detailed hydrologic and hydraulic models were developed for the South Warm Beach study area to help quantify existing and future surface water conditions and to evaluate potential solutions to identified problems. In general, the hydrologic model was used to estimate the amount of stormwater runoff that would be generated during a storm or series of storms. This data was then input into the hydraulic models, which were used to simulate routing through the stormwater conveyance system (including stream channels, wetlands, ditches, culverts, and enclosed storm drain systems).

Based on the hydrologic and hydraulic analyses that were conducted for this study, a total of nine flooding problems were identified within the study area for existing land use conditions. As the study area becomes fully developed in the future, the analyses predicted that flooding would occur at three additional locations. Some of these problems occur within public right-of-way while other problems occur on private property. Figure 6-1 shows the location of these identified flooding problems.

Of the twelve flooding problems that were identified, eight are located along neighborhood drainage systems and are caused by the inadequate conveyance capacity of these drainage systems. Three other flooding problems are located along Lake Martha Creek and are due to the inadequate conveyance capacity of existing stream culverts. The final flooding problem is located along Greenwood Creek and is likewise caused by the inadequate conveyance capacity of an existing stream culvert.

In addition to the twelve identified flooding problems, other flooding problems were predicted by the hydrologic and hydraulic analyses in the neighborhood drainage systems. However, additional field investigations are needed to confirm whether these problems would actually occur. For example, the models predicted that the drainage system along 188th Street NW would experience flooding during larger storm events. However, field investigations during moderate storm events indicated that lower flows in the ditch tended to be infiltrated into the ground, which was not accounted for by the models. While the models could be adjusted to account for these conditions, additional observations are needed during larger or prolonged storm events to confirm how the drainage system functions under these conditions.

For the twelve flooding problems that were identified, a total of eight projects were developed to address these problems. Seven of the eight projects address flooding problems only while the eighth project also addresses identified habitat problems. All of the solutions were designed to increase the capacity of the conveyance system by replacing the existing systems with larger facilities. Since the proposed projects were

generally determined to have negligible downstream impacts and since these were considered to be cost effective solutions, no alternatives solutions were analyzed.

Habitat Issues

Since drainage issues were the focus of this study, only a limited assessment of habitat conditions within the South Warm Beach study area was conducted. The main freshwater aquatic habitat features in the study area include two unnamed streams, known locally as Greenwood Creek (WRIA number 05.0456) and Lake Martha Creek (WRIA number 05.0455), and Lakes Martha and Howard. Field reconnaissance was conducted at limited locations along Greenwood Creek and Lake Martha Creek to assess stream habitat conditions as well as fish passage conditions through existing culverts. In addition, the hydraulic models of these two creeks were used to help evaluate velocities through these culverts, which affect fish passage conditions.

Both Lake Martha Creek and Greenwood Creek are ephemeral streams (i.e. stream flows are seasonal) with year-around flows only in their lowest reaches. These streams have little or no flow during the late spring, summers, and early fall. Both streams rise steeply from Port Susan on the Puget Sound to plateaus above. The steep gradients and low flows present essentially complete barriers to anadromous fish passage, and contain little or no habitat for native fish.

While no specific habitat problems were identified for Greenwood Creek, several habitat problems were identified along the lower reach of Lake Martha Creek in between Soundview Drive NW and Puget Sound. This lowest reach is a mini-estuary and is readily accessible to marine and anadromous fish species in Port Susan. The stream channel in this reach generally has a lack of diversity, large woody debris, pools, and riparian vegetation. Two of the culverts in this reach were also identified to be potential fish passage problems. One of the habitat projects therefore proposed to replace the culvert at Soundview Drive NW to improve fish passage conditions. The other habitat project proposed to remove the culvert at the beach and install stream restoration improvements in between Puget Sound and Soundview Drive NW. This project was combined with one of the proposed flooding projects since they occur in the same location.

Water Quality Issues

The primary water quality issue within the study area is associated with high fecal coliform levels in the neighborhood drainage systems, in both major streams, and in Port Susan. As a result, several agencies have conducted water quality monitoring studies in the past decade.

Section 303(d) of the federal Clean Water Act mandates that states list waters that violate water quality criteria and establish cleanup plans to restore water quality. Washington State Department of Ecology (Ecology) had previously included both Lake Martha Creek and Greenwood Creek on the 1998 303(d) list because fecal coliform measurements in both streams exceeded state standards. As an initial step in documenting fecal coliform problems and in developing a cleanup plan, Ecology prepared a total maximum daily load (TMDL) study for the Stillaguamish watershed, which included Lake Martha Creek and Greenwood Creek. Based on additional sampling, Lake Martha Creek satisfied one of the two state standards for fecal coliforms

while Greenwood Creek failed both state standards for fecal coliforms. In comparison, only one of the tributary streams that were monitored in the Stillaguamish watershed met both parts of the state fecal coliform standard. Because a TMDL study was prepared for the Stillaguamish watershed, both Lake Martha Creek and Greenwood Creek were removed from the 2002/2004 303(d) list that was recently approved.

In 1991, the Snohomish Health District surveyed the area, noting that inadequacies in onsite sewage disposal have been a long standing problem in Warm Beach (Plemel 1991). Health District staff surveyed 194 septic systems and found failures in 55 percent of the systems in the area and a 70 percent failure rate in the beachfront residences. The Health District generally defines septic failures as instances in which sewage is observed on the ground or in which treatment processes failed. Since that study, the Health District has identified and repaired numerous failing septic systems in the area.

Since 2001, the Surface Water Management (SWM) Division of Snohomish County's Public Works Department has conducted several water quality monitoring studies within the South Warm Beach study area. In 2001, SWM collected water quality samples from streams and drainage systems in the study area and along the nearshore marine waters. Based on the results, SWM identified two septic systems that were either failing or were direct connections to the drainage system with no treatment. These two failing septic systems were referred to the Snohomish Health District and have since been repaired.

To serve as partial fulfillment of Snohomish County's National Pollution Discharge Elimination System (NPDES) permit, SWM has conducted annual dry weather outfall sampling at three locations in the study area. In addition, to address ongoing concerns and to implement actions outlined in the Stillaguamish TMDL plan, SWM and the Stillaguamish Tribe conducted additional water quality monitoring during the winter of 2005 at 13 sampling stations in the study area. The results of both sampling studies indicated that one of the two state standards for fecal coliforms was exceeded at some of the sampling stations. However, additional tests to help identify the source of the fecal coliforms found that discharges were likely associated with other sources than septic systems, such as naturally occurring bacteria, wildlife, and domestic pets.

To address continued concerns, the County has applied for and received grant funding from the Centennial Fund, administered by Ecology, to address homeowner education on a County-wide basis. In addition, detection, maintenance, and repair of failing onsite systems will be conducted in targeted areas in partnership with the Health District.

Since most of the flooding problems identified by this study occur at the far west end of the study area and were not predicted to occur annually (see section 6.1), there does not appear to be any direct connection between flooding problems and failing septic systems within the study area. Since water quality problems in the residential area have historically been caused by failed septic systems, SWM water quality staff believe that continuing to fix failing septic systems once they are identified would be the most effective measure for improving water quality.

For the two lakes in the study area, Lake Martha and Lake Howard, water quality conditions are considered to be satisfactory (Snohomish County 2003). However, both lakes indicate some signs of accelerated eutrophication (the buildup of nutrients and sediment in a lake), such as increasing phosphorous build-up and regular algal blooms.

Recommended Plan

Table ES-1 provides a summary of the recommended projects for the South Warm Beach Master Drainage Plan. These are the projects that would be needed to solve most of the identified problems in the basin. Successful implementation of all ten CIP projects would result in a reduction of flooding at twelve identified problem sites and enhancement of existing habitat conditions. The individual CIP projects are listed in Table 8-2 in Section 8 of this report. Appendix C provides additional details for each project in the form of project summary sheets, which include a brief description, cost estimate, and sketch of the proposed project.

Table ES-1 Recommended CIP Projects for South Warm Beach MDP		
Type of Project	Number	Cost ¹
Flooding	8	\$378,000
Habitat	1	\$109,000
Flooding/Habitat	1	\$99,000
Total	10	\$586,000
1. 2005 dollar values		

It should be noted that none of the projects included in the recommended plan are actually required to be implemented under current County code. Furthermore, four of the ten recommended projects would primarily benefit private property owners, so the County would not be responsible to implement these projects. In order to implement the recommended plan, a number of issues will need to be resolved, such as available funding, project responsibility, prioritization of projects, detailed design, construction sequencing, and permitting.

Although a funding analysis was not conducted, it is apparent that the total cost of the recommended CIP projects for this study area as well as the areas studied by the DNR project, exceeds the County's ability to fund using current revenue sources. The County will need to consider the relative importance of the recommended projects in the South Warm Beach area with the rest of DNR study areas, in order to use the available funds most effectively.

To compare the relative benefits of individual CIP projects, the evaluation criteria that were developed for the DNR study were used to rank projects in each category: flooding and habitat. While the score assigned to a project provides a general comparison with other projects of that type, the scores do not account for some factors that could influence the implementation of the projects, such as public/private responsibility, upstream and downstream impacts, and available funding.

In addition to the CIP projects it is recommended that the following non-project actions be implemented in the South Warm Beach study area:

- Programmatic maintenance of the drainage infrastructure
- Conduct additional field reconnaissance during larger storm events to verify actual stormwater runoff and infiltration patterns in some of the neighborhood drainage systems in which additional flooding problems were identified by hydraulic models.

Completed Projects

Project WB-M3-03

During the course of conducting this study, the Surface Water Management Division of the Public Works Department at Snohomish County had funding available to construct one of the projects in the South Warm Beach study area. County staff chose to implement project WB-M3-03, which addressed the identified flooding problems along 192nd Street NW by upgrading the existing drainage system. During the final design of this project, the scope of the project was expanded to extend the culvert further downstream and to install upstream channel improvements (see photo). These improvements were completed by County road maintenance crews in 2004. The total cost of the project, including design and permits, was approximately \$64,000, which is higher than the planning level cost estimate of \$48,000 that was prepared for this study. This difference in cost was partly due to the need to conduct archeological monitoring during construction of the project and partly due to the slightly expanded scope of the project.



Project WB-M3-03 - Channel improvements and pipe inlet installed by the County in 2004 along 192nd Street NW

Completed Maintenance

Regarding maintenance of drainage systems in the study area, County maintenance crews cleaned the ditch and culvert systems in 2006 along those roads that were identified by this study as being in need of maintenance, including:

- 94th Drive NW, north of 192nd Street NW
- 95th Avenue NW, north of 192nd Street NW
- 96th Avenue NW, between 188th Street NW and Soundview Drive NW
- 98th Avenue NW, between 188th Street NW and 192nd Street NW

At 98th Avenue NW, County maintenance crews in 2006 cleaned the roadside ditch, replaced a buried culvert, and installed a new catch basin to help prevent flooding of a driveway and the roadway shoulder. The photographs on the following page show this drainage system before and after the maintenance was completed.



98th Ave NW Before Maintenance: Surface water flowing around buried culvert and downstream section of filled ditch



98th Ave NW After Maintenance: Ditch was excavated, buried culvert was replaced, and catch basin was installed