Snohomish County

Quilceda Creek Drainage Needs Report

Executive Summary

Executive Summary

The Quilceda Creek Drainage Needs Report (DNR) is one of a series of 11 drainage plans completed for most of Snohomish County's Urban Growth Areas (UGAs). The purpose of these plans is to identify flooding and surface water problems and to recommend solutions.

In order to gain a better understanding of the drainage systems, streams, and wetlands within the unincorporated Urban Growth Areas (UGAs) of Snohomish County, the Snohomish County Council authorized, in 2001, the accelerated development of drainage plans, known as the Drainage Needs Reports (DNRs) project. The purpose of the DNR project is to plan for existing and future drainage infrastructure needs in a way that identifies how to reduce road and property flooding, protect and enhance aquatic habitat, and reduce stormwater pollution. This Quilceda Creek DNR is one of the 11 individual reports that were prepared, in addition to a summary report for the entire DNR project.

Overview

Scope of Analyses: For the Quilceda Creek study area, detailed hydrologic and hydraulic models were created to analyze flooding problems along the entire main stem of Quilceda Creek, most of its major tributaries, and several local drainage systems for which flooding problems have been reported. Habitat and water quality analyses were also conducted within this study area.

The Quilceda Creek basin is located in central Snohomish County, just north of the City of Marysville. The main stem of Quilceda Creek is approximately 11 miles long, and discharges to Ebey Slough, a side channel of the Snohomish River. The geography of the Quilceda basin is dominated by the Marysville Trough, an expansive, nearly flat, alluvial plain stretching between the cities of Arlington to the north and Marysville to the south. This plain is bordered by moderate to steep slopes rising to the gently sloping Tulalip and Getchell Hill plateaus to the east and west. Significant tributaries to Quilceda Creek include Edgecomb Creek, Olaf Straad Creek, the Smokey Point Channel, Middle Fork Quilceda Creek, and West Fork Quilceda Creek.

Existing land use in the study area includes predominantly agricultural development in the north central portion of the basin with rural development along the eastern and western plateaus and denser residential and commercial land uses along the I-5 corridor, along Smokey Point Boulevard, and near the Arlington Airport. Historically, the central portion of the basin contained extensive wetlands, but these were mostly eliminated about 100 years ago when a system of ditches was created to drain fields, relocate channels, and lower the water table so lands could be used for agriculture. Currently, the primary drainage infrastructure consists of an extensive system of stream channels and drainage ditches along fields and roads. Future land use in the basin is expected to include additional commercial and residential development, particularly in the Smokey Point area and the valley portions of the basin.

This DNR Study identified a total of 63 flooding problems, 36 habitat problems, and 23 combination (flooding and habitat) problems within the Quilceda DNR. The majority of

the flooding problems were a result of undersized culverts, many of which were installed to provide access over the streams and which did not consider drainage issues or fish passage. Because the Quilceda basin is so flat, undersized culverts can result in significant ponding of water over roads and fields during flood events. As development has increased wetlands have been altered or built upon, this has become more problematic due to the loss of flood storage and the resultant increase in runoff. In addition to stream channel capacity problems, the groundwater table in some areas of the basin, particularly to the north, tends to be very near the surface during the rainy season, thereby impeding infiltration, increasing runoff, and exacerbating flooding. The identified habitat problems in this basin include fish passage barrier culverts, inadequate vegetation, and large wood in the channels. The number and types of problems found in Quilceda Creek are typical of urbanizing areas. Many of these problems result from development of the area, where the existing drainage infrastructure is unable to handle the increased stormwater associated with more urban land-uses.

To address the identified flooding and fish passage problems, several basin-wide alternative solutions, which generally consist of different combinations of conveyance and detention improvements, were developed. The recommended alternative consists primarily of culvert replacement projects, but also includes four regional detention facilities to help reduce peak flows. Typical habitat projects included in the recommended plan include culvert replacements to eliminate fish passage barriers and revegetation improvements along stream channels and adjacent riparian corridors. A typical water quality project consists of retrofitting roadside ditches into biofiltration swales to better treat stormwater runoff.

A total of 91 projects are included in the recommended plan for the Quilceda Creek study area. These would address the most significant flooding, habitat, water quality, and erosion problems identified in the basin. In addition, a number of non-project actions, primarily aimed at improving water quality, are recommended. Implementation of the recommended plan would mitigate flooding at 59 problem sites, enhance existing habitat conditions, and improve water quality in the basin.

The recommended projects were grouped into five categories, based on the types of problems addressed. The first four categories are for projects that primarily address a single type of problem: flooding, habitat, water quality, or erosion. The final category includes projects that address both flooding and habitat problems. The estimated cost to implement all recommended CIP projects is $33.4 million, as shown in Table ES-1.

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, the recommended projects include some that would primarily benefit private property owners, for which the County would not be responsible. 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, permitting, etc.

Table ES-1
Recommended CIP Projects for the Quilceda Creek Basin

33	Flooding Projects	$4,974,000
31	Habitat Projects	$7,668,000
4	Water Quality Projects	$514,000
1	Erosion Project	$145,000
22	Flooding/Habitat Projects	$20,103,000
91	**Total Recommended Projects**	**$33,404,000**

Study Area Characteristics

The Quilceda Creek DNR basin, located just north of the Snohomish River in central Snohomish County, covers an area of approximately 23,850 acres. The main stem of Quilceda Creek is approximately 11 miles long, with headwaters located east of State Road 9 on the upland Getchell Plateau. The main stem of the creek traverses the center of the basin from north to south between the Arlington and Marysville UGAs. Watershed geography is dominated by the Marysville Trough, an expansive, nearly flat, alluvial plain. Significant tributaries to Quilceda Creek include Edgecomb Creek, Olaf Straad Creek, the Smokey Point Channel, Upper Quilceda Creek, Middle Fork Quilceda Creek, and West Fork Quilceda Creek.

For the purposes of the DNR analyses, the Quilceda Creek study area was divided into four subbasins as follows:

- Smokey Point
- Middle Quilceda
- West Quilceda
- Lower Quilceda

The extent of each of these subbasins is shown in Figure 6-1. Some of the general characteristics of each subbasin are described below.

Smokey Point Subbasin

The Smokey Point DNR subbasin includes tributaries Edgecomb Creek, Olaf Straad Creek, and the east and west branches of the Smokey Point Channel. This subbasin encompasses a total area of approximately 4,400 acres extending from the upland plateau near Highway 9 above Arlington to approximately 132nd Street NE. Existing land use in the Smokey Point subbasin is primarily agricultural and rural development, with the exception of commercial development along Smokey Point Boulevard and the Arlington Municipal Airport. These commercial properties are primarily within the city limits of Marysville and Arlington. Anticipated future land use in the Smokey Point subbasin includes substantial commercial and high density residential developments concentrated primarily in the flatter portions of the basin between 172nd Street NE and 136th Street NE.

Middle Quilceda Subbasin

The Middle Quilceda DNR subbasin includes the Upper and Middle Fork Quilceda Creek tributaries, which drain approximately 5,700 acres. Land-use in the Middle Quilceda Creek subbasin is characterized by primarily agricultural and rural development with some medium density residential and retail land use. Anticipated future land use in the Middle Quilceda sub basin includes commercial and moderate density residential developments within the UGA areas and lower density residential development on the outlying areas.

West Quilceda Subbasin

The West Quilceda DNR subbasin drains approximately 6,700 acres encompassing most of the area west of Interstate-5. Significant tributaries to the West Fork of Quilceda Creek include the Fire Trail system, and the Gissberg Tributaries. Current land-use in the West Quilceda subbasin is primarily low to moderate density residential and agricultural development with some commercial development, primarily concentrated

along the I-5 corridor. Anticipated future land use in the UGA portion of the West Quilceda subbasin includes substantial commercial and high density residential developments.

Lower Quilceda Subbasin

The Lower Quilceda DNR subbasin includes the mainstem of Quilceda Creek and drains approximately 6,245 acres upstream of the confluence with Ebey Slough. The Lower Quilceda Creek subbasin is developed primarily in medium density residential and commercial land uses east of Interstate-5 and agricultural or rural land uses west of Interstate-5, with the exception of the commercial I-5 corridor.

Flooding

Detailed hydrologic and hydraulic models were developed for the Quilceda Creek basin to help quantify existing and future surface water conditions within or related to the DNR study area and to evaluate potential solutions to identified problems. In general, hydrologic models were 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).

A total of 25 flooding problems were identified in the Smokey Point subbasin, 16 were identified in the Middle Quilceda subbasin, 4 were identified in the Lower Quilceda subbasin, and 41 were identified in the West Fork subbasin. The flooding problems in each subbasin are described briefly below and more completely detailed in Section 8.

Of the flooding problems identified in the Smokey Point subbasin, 24 were the result of inadequate conveyance capacity at culverts and one was the result of high tailwater in Edgecomb Creek, which causes backwater flooding up a storm drainage line near 54th Drive NE. The most significant flooding in this basin appears to be on Lower Edgecomb Creek upstream of the culvert under the Burlington Northern railroad. Although the railroad itself was only predicted to flood under future land-use conditions, backwater effects from this culvert appear to significantly affect flooding at upstream culverts near 152nd Street NE. Flow constrictions at the railroad culvert may also cause overflows to the Smokey Point East channel, exacerbating flooding in that system.

Of the 16 flooding problems identified in the Middle Quilceda subbasin, twelve were the result of undersized culverts and four were at locations where low banks and high flows resulted in overbank flooding of private property. One of the most significant problems appears to be property flooding near 139th and 140th Place NE, adjacent to Upper Quilceda Creek. Observations by residents, supported by the hydraulic modeling, indicate that this location has flooded several times in the past 10 years. Multiple beaver dams in the channel downstream of this location and sedimentation near the point where flows break out of the channel are likely contributors to this problem.

Three of the four problems identified in the Lower Quilceda subbasin were culverts with inadequate conveyance capacity. The fourth was a catch basin on 51st Avenue NE. All of these problems were within the storm drainage network south of 108th Street NE and east of Shoultes Road. Simulations indicate that all of these problems would recur at about the 10-year level. Several of these problems seem to be related to maintenance

issues (sediment or debris in the channel) and indications are that flooding may be exacerbated by high groundwater levels.

A total of 41 flooding problems were identified within the West Fork Quilceda subbasin. This number is roughly equal to the total number of problems identified in the other three DNR subbasins combined. Of these 41 problems, nearly all (40) were directly related to inadequate conveyance capacity in existing culverts. Capacity constraints cause flooding of roads, driveways and, in some cases, adjacent properties. Many of the flooding problems predicted for existing conditions correspond with historical problems that have either been observed by County staff or that have been reported to the County by local residents. This fact, coupled with the model calibration efforts, helped to lend credence to the results of the hydrologic and hydraulic analyses.

After evaluating the above flooding problems, the hydrologic and hydraulic models were used to evaluate potential solutions to these flooding problems as well as to the identified fish passage problems. The potential solutions were grouped into three alternatives for the entire Quilceda Creek basin. The first alternative, identified as CIP Modeling Alternative 1, addresses flooding and fish passage problems primarily by increasing the capacity of the conveyance system. The second alternative, CIP Modeling Alternative 2, addresses these same problems through a combination of conveyance improvements and five major stormwater detention facilities. The detention facilities consisted of one large detention pond along the Smokey Point West channel and four stream corridor projects that would increase the storage capacity of the existing floodplain and restore habitat conditions along the stream corridor. Increased floodplain storage was located along Edgecomb Creek, the Upper Middle Fork of Quilceda Creek, the Upper West Fork of Quilceda Creek, and the Gissberg Tributary to the West Fork of Quilceda Creek. The third alternative, CIP Modeling Alternative 3, is similar to Alternative 2 except that one of the regional floodplain detention facilities was removed.

In general, all three modeling alternatives were found to be equally effective in eliminating the identified existing and potential future flooding and fish passage problems in the basin. For Modeling Alternative 1, the majority of the reaches in the Quilceda Basin were predicted to experience an increase in peak flows due to the increased conveyance capacity of the culverts that would be replaced and the corresponding loss of instream storage upstream of the culverts. In some cases, this increase in flows caused new flooding problems to be identified and resulted in the need to replace additional culverts. For Alternative 2, the proposed detention facilities were effective in reducing downstream flows and would eliminate the need to replace a few culverts, but most of the identified flooding problems would still require culvert replacements to eliminate the flooding. In some cases, these facilities were able to offset the increase in peak flows caused by the proposed conveyance improvements, and in other cases, the peak flows were reduced even further. Alternative 3 is similar to Alternative 2 except that one of the floodplain detention facilities in the West Quilceda subbasin was removed. Based on factors such as flow change and total cost, CIP Modeling Alternative 3 is recommended. Although Alternative 3 has a significantly higher cost than Alternative 1, it provides substantial additional benefits with respect to flow duration control since it would roughly offset the increase in peak flows caused by the proposed conveyance improvements.

Besides the four recommended detention facilities, the majority of the proposed projects in Alternative 3 consist of replacing existing culverts with larger culverts to improve their conveyance capacity and to reduce the potential for flooding and fish passage problems. A total of 62 projects that address flooding problems only or a combination of flooding

and habitat problems were selected for inclusion in the Quilceda Creek DNR recommended plan.

Habitat

Aquatic habitat assessments were performed in many drainage basins within the County, including the Quilceda Creek DNR study area. Data from these assessments were combined into a regional analysis to make it possible to explore relationships among physical and habitat/biological variables over a broader range of conditions than would be found in any one drainage area. The results of the regional analysis conducted for the DNR project are provided in a separate document, *Aquatic Habitat Summary: Current and Future Conditions of Urban and Urbanizing Streams of Snohomish County* (Snohomish County, 2002).

For the habitat assessment, sites were selected for examination and data collection that are thought to be representative of the variety of habitat conditions found within the Quilceda basin. Out of 31.4 miles of fish-bearing streams in the entire Quilceda basin, 9.3 miles are located within the unincorporated UGA. Of this, 3.7 miles of stream were surveyed for this project, which was combined with additional survey data. The habitat assessment at these sites focused on instream habitat, biotic condition, and fish passage issues as described below. In addition, riparian areas along fish-bearing streams and wetlands within the unincorporated areas of the Quilceda Creek basin were evaluated using recent aerial photos. Analysis was then performed to examine interrelations between habitat components and factors that could affect habitat quality.

Based on the habitat assessment, a total of 59 habitat problems were identified in the Quilceda Creek basin. Roughly 80 percent (47) of these problems consisted of partial or complete barriers for fish passage, mostly related to existing culverts.

The lack of instream large woody debris (LWD) was identified as a problem in areas in both the West Fork of Quilceda Creek and within the agricultural areas of the mainstem and Middle Fork of Quilceda Creek. Three areas in the basin were identified as having bank erosion problems due to livestock access to the streambanks. Excessive fine sediment delivery was identified as a problem, in addition to the lack of off-channel habitat, areas lacking adequate protection for habitat, and abundant invasive vegetation in the Quilceda Creek basin. Low LWD recruitment and low shade protection was identified as a habitat problem in 45 riparian units in the basin.

In considering potential projects to address the identified habitat problems, two habitat options were analyzed. Habitat “Option A” consists of the entire list of projects that would solve all of the identified habitat problems with the exception of fish passage culverts being modeled for the three CIP modeling alternatives. Habitat “Option B” consists of the highest priority and most cost-effective projects contained in Option A.

As discussed in Section 7, current County code does not require that either of these two options be implemented. Both options represent a list of opportunities that, if constructed, would help to alleviate existing habitat problems, such as the lack of instream pools or adequate shade. But neither option represents a specific standard that the County is required to achieve.

Since Option B represents the highest priority and most cost-effective habitat projects, the CIP projects in this option are recommended. These CIP projects include installing LWD along stream corridors, planting various types of native riparian vegetation, removing invasive vegetation, and installing log weirs. Permission to access private land

will be necessary for all of the recommended habitat CIP projects. In addition to the proposed culvert replacement projects, a total of six habitat CIP projects are included in the recommended plan for the Quilceda Creek basin. The habitat recommendations included in this DNR are consistent with and complement the habitat management recommendations provided in the *Quilceda/Allen Watershed Management Plan* (Snohomish County, 1999).

Water Quality

An assessment of existing water quality conditions and associated problems within the Quilceda Creek basin was also performed. It included characterization of existing water quality conditions in surface waters of the basin, as well as a discussion of general and specific water quality problems in the DNR area. The water quality analysis is primarily based on review of available data and reports with limited field observation. Although the characterization of existing water quality conditions is based on information covering the entire Quilceda Creek basin, the identification of specific water quality problems and potential improvements focused on the DNR study area.

The data evaluation indicates that the overall water quality of Quilceda Creek is poor. Sampling has shown that the stream is not meeting Washington State Class A criteria for fecal coliform bacteria and dissolved oxygen. Segments of the stream are on the Washington Department of Ecology's 1998 Clean Water Act Section 303(d) list for both fecal coliform bacteria and dissolved oxygen problems, with total maximum daily load (TMDL) actions required. Elevated levels of nutrients (nitrate- and nitrite-nitrogen and total phosphorus) are regularly detected in the surface waters of the basin, and are suspected to contribute to the stream's low dissolved oxygen concentrations. Metals such as copper, lead, and zinc have also been detected in water and sediment samples from the basin. The middle and lower reaches of Quilceda Creek also exhibit excessive sediment deposition that is likely due to high sediment loads in storm events. Impaired uses of Quilceda Creek include swimming, wading, and salmon and other fish spawning, migration, rearing, and harvesting.

The primary sources of these contaminants are runoff from commercial areas, residential neighborhoods and roadways, excess sediment from eroding stream banks and construction sites, septic system failures, manure that is stockpiled and applied on large commercial farms and small, non-commercial farms, fertilizers, and animal access to the streams. Agricultural land use in the Quilceda Creek basin is a significant contributor to the poor water quality.

Two specific water quality problems were identified within the Quilceda Creek basin. These problems are associated with particularly degraded stream banks and livestock access to the streams on agricultural lands. Many other general, nonpoint sources of water quality problems are evident in the basin. A limited number of water quality CIP projects were developed because flooding and habitat projects will or can include water quality benefits, and because the cost-effectiveness of many potential water quality CIPs (such as retrofitting of runoff treatment for a small portion of an established residential neighborhood) would generally be low. Four CIP projects, specific to water quality, were chosen for the Quilceda Creek DNR Recommended Plan. These projects consist of retrofitting two existing detention ponds and two existing drainage ditches in the basin to include water quality features. Additional programmatic recommendations for water quality improvements (i.e., actions that are not specific CIPs) were also developed.

To achieve significant improvements in water quality in Quilceda Creek, the quality of stormwater runoff from urban areas within the cities of Marysville and Arlington (outside Snohomish County jurisdiction) would need to be made, and commercial and non-commercial farms throughout the watershed would collectively have to implement more effective best management practices.

Collectively, the water quality recommendations developed for this DNR are consistent with the objectives of the *Quilceda/Allen Watershed Management Plan*, and would complement the recommendations presented in that plan.

Erosion and Sedimentation

In general, channel erosion and sedimentation problems were not evaluated for the Quilceda Creek DNR. However, through investigations performed for the assessment of flood control projects, an erosion problem area was identified at a storm drain outfall near the intersection of Shoultes Road and 108th Street. A CIP project was developed to solve the identified erosion problem and was included in the recommended plan.

Recommended Plan

Table ES-1 provides a summary of the recommended projects for the Quilceda Creek DNR. These are the projects that would be needed to solve most of the identified problems in the basin. Successful implementation of all 91 CIP projects would result in a reduction of flooding at 59 identified problem sites, enhancement of existing habitat conditions, and modest improvements to water quality. The individual CIP projects are listed in Tables 10-3 through 10-7 in Section 10 of this report. Appendix E 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.

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, the recommended projects include some that would primarily benefit private property owners, for which the County would not be responsible. 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 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 Quilceda DNR 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, evaluation criteria were developed and used to rank projects in each category: flooding, habitat, water quality, and erosion. 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 Quilceda DNR area:

- Programmatic maintenance of the drainage infrastructure

- Additional analysis and monitoring for two conveyance systems, including the overflow at Edgecomb Creek and the local drainage system in which a SWMM model was constructed in the Lower Quilceda subbasin
- Additional analysis to evaluate the need to retrofit existing detention ponds to improve water quality and/or increase storage capacities
- Additional analysis to evaluate the need to retrofit existing ditches to improve water quality
- Additional analysis to identify and evaluate erosion and sedimentation problems in the basin
- Coordination with the City of Marysville to implement water quality improvements
- Implementation of small farm Best Management Practices (BMPs)
- Sweeping of public parking lots
- Cleaning catch basins in targeted areas