May Creek Drainage Improvement Project

Biological Evaluation Report for:

Chinook Salmon and Steelhead Trout as protected under the Endangered Species Act

May Creek, King County, Washington State

Prepared for:

King County Water and Land Resources Division

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Acronyms

BE	Biological Evaluation
BMP	Best Management Practices
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ESA	Endangered Species Act of 1973 (amended 1996)
ESU	Evolutionarily Significant Unit
HUC	Hydrologic Unit Code
LWD	Large Woody Debris
NOAA Fisheries	National Oceanic & Atmospheric Administration – Fisheries Department
NMFS	National Marine Fisheries Service
RM	River Mile
SPCC	Spill Prevention, Control, and Countermeasures
TESC	Temporary Erosion and Sediment Control
WDFW	Washington State Department of Fish and Wildlife
WLRD	King County Water and Land Resources Division
WRIA	Water Resource Inventory Area
WSDNR	Washington State Department of Natural Resources

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1 INTRODUCTION

1.1 Consultation Activities

No consultation with National Marine Fisheries Service (NMFS) has occurred. Species under NMFS jurisdiction were investigated through the development of a series of special studies completed as part of the project selection process, as well as by means of personal communications with local fish and wildlife authorities and a review of pertinent literature. The personal communication included conversations with Larry Fisher, Area Habitat Biologist and Aaron Bosworth, Anadromous Fish Biologist for the Washington Department of Fish and Wildlife (WDFW). The literature review included: the WDFW Priority Habitats and Species database and species maps (dated October 29, 2010); the Washington State Department of Natural Resources (WSDNR) Natural Heritage Information System, and list of rare plants and high-quality native plant communities and wetlands in King County.

1.2 Description of Proposed Project Action

The purpose of this Biological Evaluation (BE) is to determine if the proposed action may affect any species listed by the NMFS. Section 7(c) of the Endangered Species Act (ESA) requires that projects with a federal nexus evaluate and document impacts to threatened and endangered species and their critical habitats before funding, authorizing, or carrying out an action that may affect the species or their environment. A BE is necessary for this project because of its federal permit (from the Army Corps of Engineers). Information on listed species and habitats known or potentially occurring in the project vicinity was provided by state and federal agencies (Appendix A) and is summarized below (Table 1).

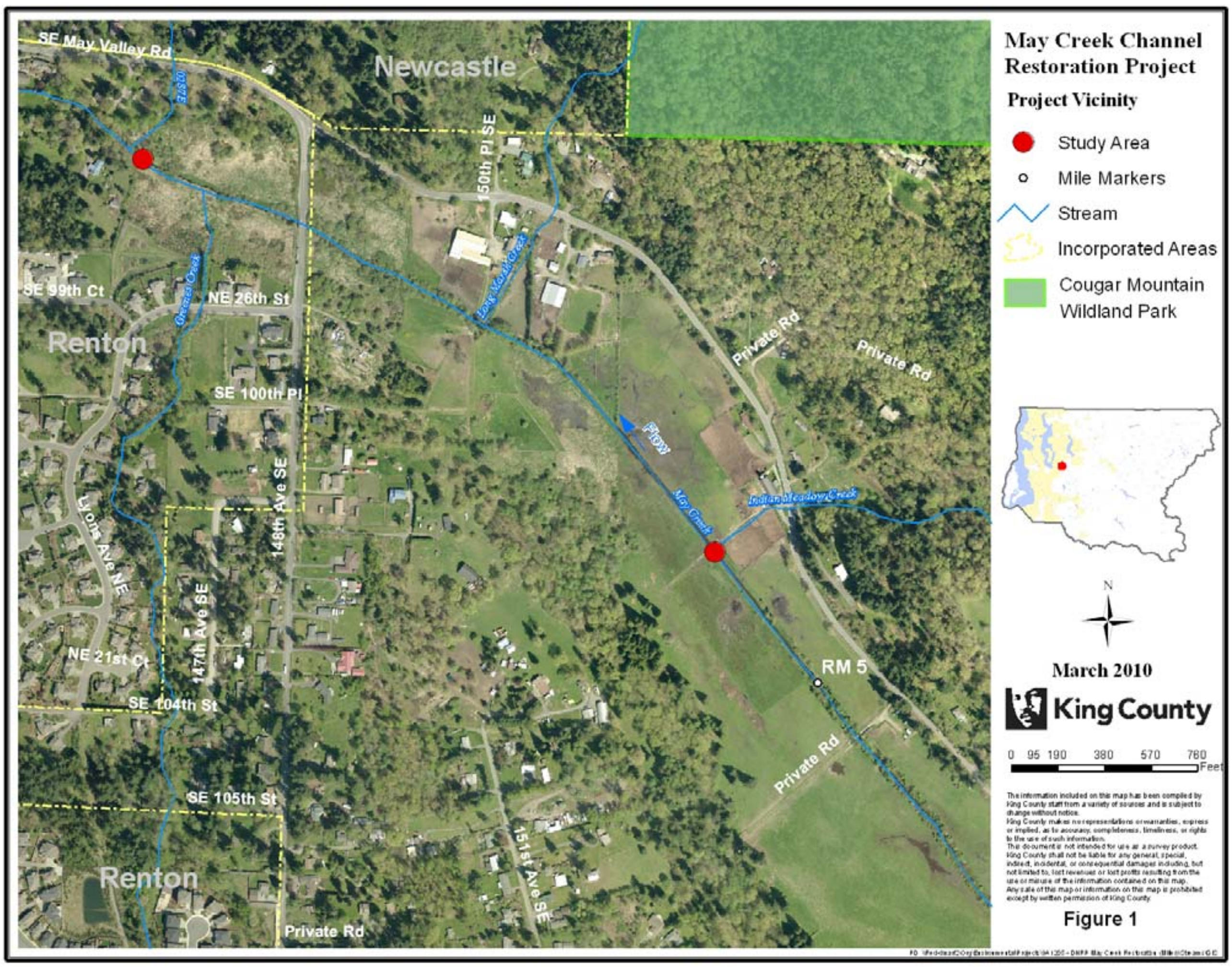
Table 1: Information on Listed Species in the May Creek Project Action Area

Species and Habitats	Agency	Data Provided
Federally threatened endangered, and proposed plant species and communities	WDNR	No species or communities occur in the project action area.
Federally threatened and endangered and proposed fish species	NMFS	Two threatened species could occur in the project action area: **1**-Puget Sound Chinook salmon ESU **2-**Puget Sound steelhead trout DPS
Critical habitat for federally threatened and endangered species	NMFS	No critical habitat is present in the action area

King County Department of Natural Resources and Parks, Water and Land Resources Division (WLRD), proposes to improve in-stream flow conditions along segments of May Creek. Sediment accumulation and in-stream vegetation (e.g., reed canarygrass and

The project is located in unincorporated King County and the City of Renton in Sections 2 and 3 of Township 23 North, Range 5 East (47.51521 N latitude / -122.14301 W longitude) (Figure 1). The May Creek drainage basin is part of the Lake Washington watershed (6th field HUC 171100120301). The project is located in the May Valley and construction activities will directly impact May Creek (WRIA 08.0282) and Long Marsh Creek (WRIA 08.0289).

Figure 1. May Creek Drainage Improvement Project Vicinity Map



1.2.1 Description of Project Elements

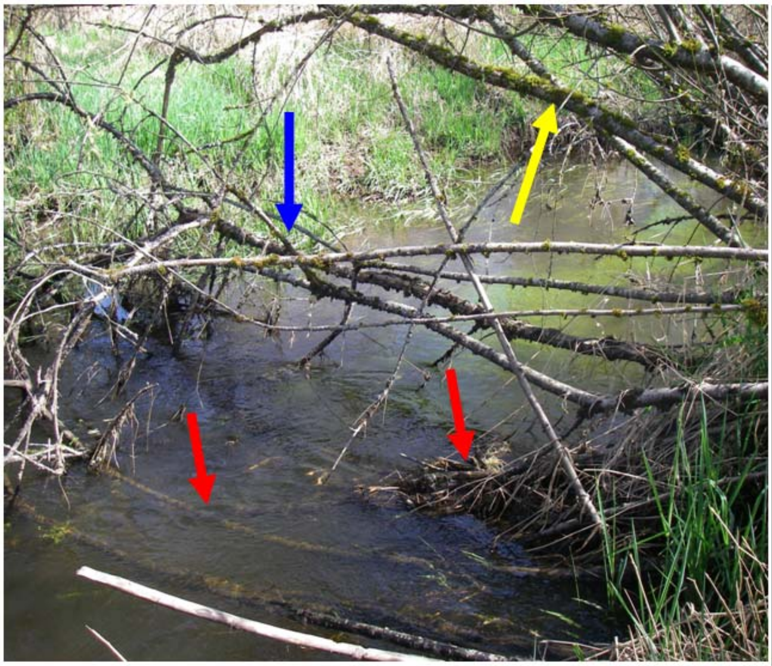
King County's Water and Land Resources Division proposes to improve in-stream flow conditions along segments of May Creek in May Valley between approximately River Mile 4.3 and 4.9. This project proposal consists of three components: vegetation removal, sediment removal, and stream/wetland mitigation. The vegetation and sediment removal will negatively impact existing in-stream fish habitat, so mitigation has been proposed to offset these impacts. The mitigation is also designed to improve the longevity of the project by decreasing the opportunity for channel obstructions to form in the future.

A temporary erosion and sediment control (TESC) plan will be implemented. TESC measures will be installed, inspected, and maintained throughout construction as determined by the plan. Control measures will be installed and in place prior to ground-disturbing activities. All clearing limits, staging area perimeters, and site boundaries will be flagged and/or fenced.

1.2.1.1 Vegetation Removal

The first component of the project includes removal of approximately 2,550 linear feet of flow obstructing in-stream vegetation and debris from specific reaches where it is choking the channel creating a backwater effect. Water trapped behind these channel constrictions result in extended periods of flooding on adjacent properties during storm events. Invasive reed canarygrass is the dominant vegetation that will be removed from the channel and banks. In addition, willows located in multiple locations throughout the project area, are currently growing in the middle of the channel, further contributing to the backwater effect. A portion of the willows (along approximately 1,070 linear feet) that are identified as obstructing flow would be removed (Figure 2). The willows will be primarily removed by hand, but some small, hand-held, mechanized machinery may also be used. The reed canarygrass that is growing in the channel will be removed with machinery, most likely a trackhoe, operated from the stream bank. During removal of the reed canarygrass, the stream would be diverted around the construction site and erosion/sediment control best management practices will be implemented to minimize temporary downstream water quality impacts.

Figure 2. Willow Pruning Exhibit



The selective pruning of the existing willows would be done as shown in the attached picture. The objective of the pruning would be to reduce the branches that cross the stream and catch reed canary grass mats that break loose upstream.

1. The willow branches (red arrow) that are below the water would be pruned back to the main trunk of the willow.
2. The willow branches (blue arrow) would be pruned so that they would not block flows that are contained within the stream banks.
3. The willow branches (yellow arrows) that provide the shade canopy for the stream would not be touched.
4. The root system of the willow that is providing bank stability and stream complexity would not be touched.

1.2.1.2 Sediment Removal

The second component of the project includes the removal of accumulated sediment from the stream channel. Sediment would be removed using machinery, most likely a trackhoe, operated from the stream bank. As with the vegetation removal process described in section 1.2.1.1., the stream would be diverted around the construction site and erosion/sediment control best management practices will be implemented to minimize temporary downstream water quality impacts. Construction techniques, such as utilizing existing access roads or using non-permanent steel plates (or equivalent) where additional access is needed, would be used to minimize temporary impacts to adjacent wetlands.

Approximately 4,050 cubic yards of material will be removed from the stream channel. Sediment removed from the stream will be temporarily stockpiled in designated soil drying areas (Appendix B, Sheet 2 and 3) immediately after removal from the stream. Once the soil is dry, it will be hauled offsite and disposed of at an approved location.

1.2.1.3 Channel Modification

May Creek's channel will be modified by the dredging activity, as well as by in-stream mitigation activities. The dredging activities will result in a uniform channel elevation at 308 feet (NAVD 88) with varying channel cross sections (Appendix B, Sheet 4). This channel modification will occur in May Creek from approximately river mile (RM) 4.3 to RM 4.9. The dredging construction techniques were described above.

1.2.1.4 Conservation Measures

The mitigation was designed to provide compensation for removal of existing in-stream vegetation (i.e., reed canarygrass and willows) and sediment by enhancing the existing riverine wetland and riparian buffer, as well as restoring instream habitat function at the confluence of Long Marsh Creek and May Creek. King County has developed multiple basin reports and action plans for the May Creek subarea over the years and the proposed mitigation incorporates the results of these studies. The mitigation goal for this project is to increase project longevity and to achieve no overall net loss in habitat functions in the May Creek subbasin.

In most of the project area the regulatory stream buffer is contained within the delineated wetland boundary, which means that stream buffer enhancement could also be considered wetland enhancement. Compensatory mitigation objectives include:

<u>Wetland Habitat</u>: Enhance about 2.24 acres (this includes 2.0 acres of riparian habitat described below) of riverine wetland adjacent to May Creek downstream of 148th Avenue SE by suppressing invasive vegetation and replanting native wetland vegetation. About 0.24 acre of this enhancement will be in the form of off-channel alcoves along May Creek with emergent wetland vegetation, woody debris, snags, and gravels. This mitigation will enhance fish and wildlife habitat by increasing habitat complexity.

<u>Riparian Habitat</u>: Enhance about 2.0 acres (included in the 2.24 acre of wetland habitat) of riverine wetland/May Creek buffer by suppressing invasive species and planting a 15-feet wide buffer of native vegetation along both banks of May Creek from 148th Avenue SE upstream to the end of the project limits (about 2,500 linear feet on each stream bank). This buffer is intended to shade out future reed canarygrass and to compensate for the cover that would be lost by removing flow obstructing willows and reed canarygrass. The native riparian vegetation would be planted in areas where, under existing conditions, virtually no native vegetated buffer exists. Fencing will also be installed around the planting areas to minimize livestock access to the stream.

<u>In-stream habitat and function</u>: In-stream mitigation activities will occur in two locations. In the first location, 0.24 acre of off-channel alcoves (these are the same alcoves described above under Wetland Habitat) will be excavated along May Creek west of 148th Avenue SE. The existing banks will be replaced with a terrace (wide bench) and gradual slopes. Sixteen (16) pieces of large woody debris (LWD) will be placed and native vegetation will be planted in the alcoves (Appendix B, Sheet 2) and streambed gravels will be placed along the first 15 feet adjacent to May Creek. Jute matting will be placed in the alcoves beyond 15 feet to minimize erosion, and the alcoves will be densely planted with emergent and scrub-shrub wetland plants. During a flood, water will inundate the terrace and interact with the woody debris and vegetation. This will increase the amount of available in-stream habitat and will decrease flow velocities, thus improving the quality of off-channel overwintering habitat. Sediment deposition will occur outside of the main channel in the alcoves. The woody debris and vegetation will trap and hold sediment and then allow a more gradual pulsing of sediment back into the channel over time.

The second location will restore in-stream fish habitat complexity and alluvial fan functions at the confluence of Long Marsh Creek and May Creek. The project will enhance approximately 300 feet of the lowest reach of Long Marsh Creek by creating meanders, adding habitat features, and planting native vegetation. These enhancements will improve the sediment trapping capabilities of the Creek to reduce transport of sediment to May Creek. The enhancement also includes creation of an approximately 100 foot long side channel parallel to May Creek that will join with Long Marsh Creek prior to discharging to May Creek. (Appendix B)

This mitigation will improve winter rearing habitat for salmonid and other fish species in areas adjacent to the mainstem of May Creek. The mitigation will increase biological functions for riparian species within May Creek through introduction of woody debris; woody debris will also provide substrate for invertebrates, hiding habitat for juvenile fish, perching habitat for riparian birds, and desirable niches for river otters, other mammals, and crustaceans.

The proposed mitigation is also designed to enhance refuge and rearing habitat through the establishment of habitat features along May Creek. Such enhancements would make these habitat features available to salmonids and other wildlife species at a wider range of May Creek flow rates. In addition, willows and other native shrubs will be planted along streambanks and confluence margins to increase cover of overhanging branches above the waterways. Lastly, the removal of reed canarygrass and root system from the floodplain will create additional area for sediment deposition, thereby allowing some decrease in the volume of fine sediment moving downstream.

1.2.2 Project Sequencing and Timeline

Project construction is expected to take three to four weeks to complete, with plantings occurring in the spring. The timeline detailed in table 2 assumes the in-water work window issued by WDFW to be August 1-31, which is typical for tributaries to Lake Washington.

Table 2. Construction Sequencing and Timeline

Date	Activity
1-Aug	Locate and Mark Utilities
4-Aug	Install Temporary Erosion and Sediment Control (TESC) Measures
4-Aug	Install Temporary Construction Access Ramps and Entrance Pads
5-Aug	Install Staging Areas
5-Aug	Fish Removal
6-Aug	**Install Stream Bypass (in-water)**
7-Aug	Selective Removal of Vegetation
14-Aug	Sediment and Reed Canary Grass Removal (In Channel)
26-Aug	Construct Mitigation Area (grading and LWD)
30-Aug	**Remove Temporary Stream Bypass (in-water)**
1-Sep	Remove Temporary Access Ramps and Pads
17-Oct	Remove TESC Best Management Practices (BMPs)
1-Apr	Install Plantings

1.3 Impact Avoidance and Minimization Measures

The following project elements will be implemented in order to minimize project impacts on listed species.

<u>Site and Equipment Preparation:</u>

- The contractor will install temporary high-visibility fencing and silt fencing to demarcate clearing limits and protect sensitive areas according to the approved TESC plan. No work, including the placement or stockpiling of fill materials or excavated materials, will be performed in any sensitive area. When it is no longer needed or at the engineer's direction, the contractor will completely remove and properly dispose of temporary high-visibility fencing and silt fencing.

- A TESC plan and a Spill Prevention, Control, and Countermeasures (SPCC) plan will be developed and implemented by WLRD for this project and will be used at all times. As construction progresses, erosion-control measures will be re-located or newly installed if necessary so that as site conditions change erosion and sediment-control measures are always functioning in accordance with local and state erosion and sediment-control standards.

<u>Construction Equipment:</u>

- Refueling operations will be conducted at a minimum distance of 100 feet from an open water body, or ditch, and an SPCC plan will be prepared by the contractor and approved by WLRD prior to the initiation of construction to ensure that all pollutants and products are controlled and contained. Additionally, drip pans will be fitted with absorbent pads and placed under all equipment being fueled.

- All vehicles operated within 100 feet of the creek will be inspected daily for fluid leaks before leaving the vehicle staging area. Any leaks detected will be repaired before the vehicle resumes operation. When not in use, vehicles will be stored in the vehicle staging areas.
- Construction equipment will use existing farm access roads, whenever possible to cross wetlands.
- Construction equipment will not enter any water body without authorization from WDFW, as appropriate. Equipment will be operated as far from the water's edge as possible.

<u>Debris, Erosion, and Disturbed Areas:</u>

- The contractor will install temporary high-visibility fencing and silt fencing to demarcate clearing limits and protect sensitive areas according to the approved TESC plan. No work, including the placement or stockpiling of fill materials or excavated materials, will be performed in any sensitive area. When it is no longer needed or at the project manager's direction, the contractor will completely remove and properly dispose of temporary high-visibility fencing and silt fencing.
- All debris from construction and removal activities will be contained and disposed of in accordance with federal, state, and local laws.
- Erosion of disturbed areas will be controlled using silt fence staked and keyed-in (depth of five inches); use of mulching or hydroseeding, planting disturbed areas to establish cover vegetation, or other similar approved methods to contain erosion.
- All exposed areas that will be unworked for more than seven days during the dry season (May 1 to September 30) and two days during the wet season (October 1 to April 30) will be covered in accordance with the project's TESC plan.
- Disturbed areas will be restored to pre-project conditions or better, using site-appropriate native plant species.

<u>Stream Work:</u>

- In-water work will be conducted during the in-water work window listed in the hydraulic project approval issued by WDFW. Typical windows for tributaries to Lake Washington allow an in-water work window of August 1 to August 31, though final approval from WDFW has not been issued.
- In-water work will be limited to activities required to bypass the creek, including fish exclusion and installation of cofferdams. The remainder of project activities will occur once the stream has been bypassed.
- Work will not inhibit passage of any adult or juvenile salmonid species after project completion.
- Sediment-laden water generated during construction will be pumped to an infiltration or filtration site, or to a settling area, where it is subsequently treated and sediments are consolidated prior to returning water to streams. Discharge of water back to streams will occur in such a manner as not to cause erosion.
- Machinery access along the stream, in areas where there is a willow canopy, will only be allowed approximately every 50 feet to minimize disturbance to native vegetation.

- In-stream willow removal will be limited to the minimum amount required to restore flow conditions. Branches that are crossing the stream and obstructing flow will be removed by pruning the branches back to the trunk. Willows that are providing canopy cover for the stream without obstructing flow will not be removed, and similarly, the willow roots that are providing bank stability will not be removed.

1.4 Action Area

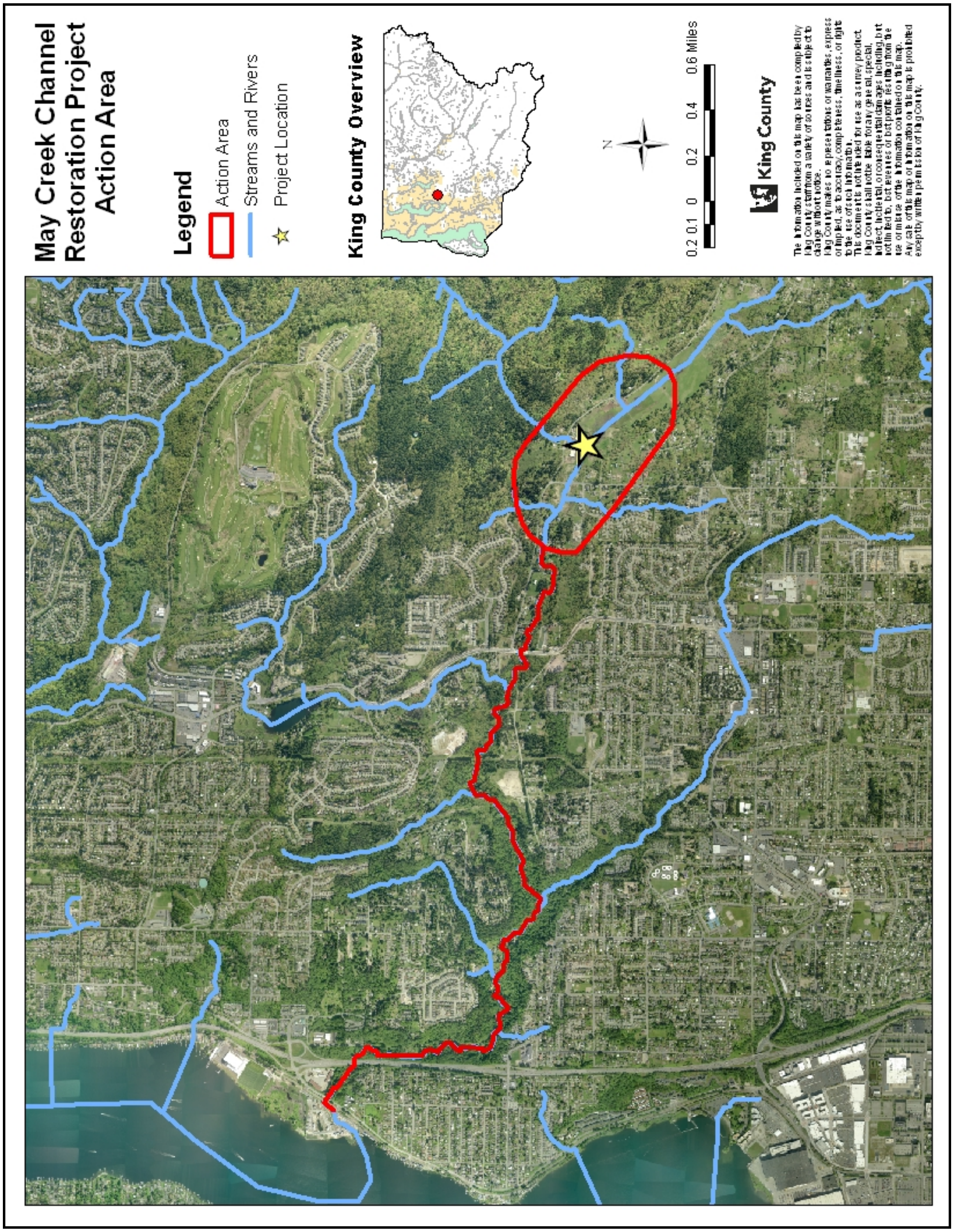
The action area includes all areas that could potentially be affected directly and indirectly by the federal action, and not merely the immediate area involved in the action (50 CFR 17.11). This area is the geographic extent of the physical, chemical, and biological effects resulting from the Project, including direct and indirect effects, and effects of interrelated and interdependent activities. Effects from the project are not expected beyond the action area (Figure 3).

<u>Terrestrial:</u>
The terrestrial portion of the action area is delineated by the point at which project related noise generated by construction equipment attenuates to background noise levels. Construction noise levels where estimated assuming use of dump trucks and trackhoe/excavator and the distance at which noise levels attenuate to background is 1,200 feet.

<u>Aquatic:</u>
In the aquatic portion of the action area, the effects from project activities would occur through water-quality impacts. Direct effects from turbidity and siltation resulting from construction activities will be minimized through the implementation of BMPs and impacts are not expected to extend beyond 100 feet downstream as required under Washington Administrative Code 173-201A-200. This limit was established based upon the type of construction activities that are to occur, the location of those activities in relationship to the creek, timing of construction, and the implementation of BMPs through the TESC plan.

Indirect effects resulting from reductions in sediment transport may extend 3.2 miles downstream of the project, near the confluence with Lake Washington. Sediment potentially transported this distance is assumed to deposit in the lower 2,000 feet of May Creek, where the gradient becomes less than one percent.

Figure 3. Project Action Area



2 FEDERALLY LISTED FISH AND WILDLIFE SPECIES IN THE ACTION AREA

Based on a review of an endangered species listing provided by the WDNR (dated November 5, 2010) and NMFS (accessed January 24, 2011; revised July 1, 2009) the following species have been evaluated as part of this biological evaluation: Chinook salmon and steelhead trout (Table 1).

2.1 Chinook Salmon

In 1998, NMFS conducted an ESA status review of Chinook salmon populations from Washington, Idaho, Oregon, and California and determined that Chinook salmon in the Puget Sound region constituted an evolutionary significant unit (ESU) and that the Puget Sound ESU is at risk of becoming endangered in the foreseeable future (Meyers et al., 1998). Following this status review, the Puget Sound ESU was federally listed as threatened in 1999 (Federal Register 1999). Primary factors attributed to population declines include habitat blockages, hatchery introgression, urbanization, logging, hydropower development, harvests, and flood control and flood effects (NMFS 1998).

Chinook salmon are not present at the project location, but have been documented approximately one mile downstream, within the project action area; lifestages present include adult spawners and rearing juveniles. Adult Chinook typically arrive on the spawning grounds in May Creek in October and finish spawning in November. Fry begin emerging in January and continue through early- to mid-March. Juveniles typically rear in fresh water for a few months before migrating downstream in the spring.

Chinook in May Creek likely represent fish straying from the Cedar River and Issaquah Creek and do not represent a reproducing population. Nearly all spawning occurs in the lower two miles of May Creek, though spawning has been observed up to RM 3.0. The number of Chinook observed in May Creek varies between zero and 12 fish annually (*pers. comm.* Aaron Bosworth, WDFW, November 15, 2010). Preliminary results of WDFW spawner surveys conducted in 2010 in May Creek observed three live Chinook and one redd. Surveys were conducted weekly from September 22 to November 10 and the Chinook were observed on a single survey within the middle reach (RM 0.4 to 1.8).

2.1.1 Critical Habitat

No critical habitat is designated in May Creek; the nearest critical habitat for Chinook salmon occurs in Lake Washington approximately 4.3 miles downstream of the project location, below the downstream extent of the action area.

2.2 Steelhead Trout

Puget Sound steelhead were listed as a threatened species on June 11, 2007 (FR Vol 72, No 91 p 26722). The DPS includes all naturally spawned anadromous winter-run and summer-run steelhead populations, in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), as well as the Green River natural and Hamma Hamma winter-run steelhead hatchery stocks. *O. mykiss* can be anadromous or freshwater resident (and under some circumstances, apparently yield offspring of the opposite form). Anadromous *O. mykiss* are called steelhead and non-anadromous (freshwater resident) forms of the species are usually called rainbow trout. Those that are anadromous spend one to four years in fresh water prior to smoltification, although most within the Puget Sound ESU smolt after two years in fresh water. Steelhead then spend one to four years at sea before returning to their natal streams to spawn.

The steelhead run in the Lake Washington basin is characterized as "depressed" (WDFW, 1992). Past hatchery practices by WDFW included planting of steelhead fry throughout tributaries in the Lake Washington/Lake Sammamish Basin and were unsuccessful in producing return adult spawners. The Cedar River has a naturally spawning population of steelhead and weekly surveys are conducted annually to assess abundance. Redd counts have been steadily declining and 2010 surveys observed only one redd (*pers. comm*. Hans Berge, King County, November 22, 2010).

Steelhead occurring in the project action area are part of the Lake Washington winter-run population. They typically enter fresh water between November and April and spawn from late-March through early June. Survey data from 1984 though 1987 observed steelhead in the lower reaches of May Creek (Newcastle 2002). Data from the WDFW Salmon Scape website (accessed November 22, 2010) report that steelhead have been observed in the lower three miles of May Creek, with the nearest observation 0.75 mile downstream of the proposed project.

2.2.1 Critical Habitat

Critical habitat has not been designated for the Puget Sound steelhead DPS.

3 ENVIRONMENTAL SETTING

3.1 May Creek Basin Overview

The mouth of May Creek is located on Lake Washington approximately two miles north of the Cedar River in Renton, Washington. The May Creek Basin drains an area approximately 14 square miles west of the Cascade Foothills between Issaquah Creek, Coal Creek, and the Cedar River. The headwaters of the basin include Cougar Mountain, Squak Mountain, and the East Renton Plateau. The main stem of May Creek contains approximately seven river-miles of habitat and is fed by 13 primary tributaries. There are two lakes in the drainage, Lake Kathleen and Lake Boren that form the headwaters of the South Fork May Creek and Boren Creek, respectively. The northern portion of the basin includes Cougar Mountain Regional Wildland Park and some low-density residential development (City of Newcastle 2002). In the flat floodplain and wetlands of May Valley, the creek broadens and slowly flows through rural pastures, small commercial areas, and suburban development (King County 2001). Land use in the southern May Creek basin includes low and high-density single-family development, commercial development, forest lands, and meadows.

May Valley is largely composed of a natural floodplain that periodically filled with floodwaters even before this region was settled. May Valley was cleared and drained around the beginning of the last century, and has supported agricultural and residential uses ever since. Sediment eroded from streams in the Highlands and East Renton Plateau is gradually reducing the capacity of the May Creek channel in May Valley and until the 1990s, portions of the channel were maintained by landowners who removed sediment deposits and stands of choking vegetation (King County 2001). Analysis of past, existing, and forecast storm runoff and flooding conditions of the May Creek Basin indicate that flooding has increased significantly and will probably continue to increase as the basin is developed (KCSWM, 1995). As more development occurs throughout the basin, many of these problems are anticipated to worsen unless steps are taken to address these issues (King County 2001).

3.2 Habitat Conditions at the Project Location

3.2.1 Aquatic Resources

Aquatic resources directly impacted by the proposed project include May Creek and Long Marsh Creek. Stream surveys were conducted and the results are summarized below, additional detailed information can be found in the King County Baseline Stream Conditions Report (2010).

<u>May Creek</u>

May Creek at the project location is dominated by slow water glides. The creek has two primary channel forms, which are influenced by the riparian plant community. In areas where willows are present and in contact with stream flow, the channel form appears to be mostly forced pool riffle, with pools being forced by scour against channel-spanning willow branches or willow stems within the active channel. In areas where riparian vegetation consists of reed canarygrass or trees high on the banks, the channel form appears to be plane-bed. Both channel forms derive from past excavations and ditching for agriculture and sediment deposition. The channel gradient is flat throughout.

Aquatic habitat is more complex in places where the riparian corridor has woody plants, such as willows, engaged with the stream channel and connected floodplain. Overhanging or rooted willow branches or stems provide cover and hard points necessary for bedform complexity, producing both turbulent and non-turbulent flow areas (King County 2010). Areas with no woody riparian plants are much more uniform and tend to have accumulations of fine sediments in the channel (Photos 1-5).

<u>Long Marsh Creek</u>

Long Marsh Creek is a tributary of May Creek that drains portions of the south side of Cougar Mountain. In-stream habitat below SE May Valley Road is somewhat shallow low-gradient riffle with little to no pools. The stream is maintained in a relatively straight alignment by property owners to the streams confluence with May Creek (Photo 6).

Photo 1. Looking upstream toward Red Barn
August 2010

Photo 2. Looking upstream toward Red Barn
February 2010

Photo 3. May Creek looking downstream
August 2010

Photo 4. May Creek looking downstream
February 2010

Photo 5. May Creek channel

Photo 6. Long Marsh Creek, looking upstream from May Creek

3.2.2 Wetlands

One large riverine wetland, referred to as May Creek #5 in the King County Wetland Inventory (1990), is located at the project location. This wetland is approximately 140 acres in total size, and approximately 25 acres of it is contained in the project study area that was delineated for this project (King County, 2010). The results of the delineation report are summarized below.

May Creek #5 is a Category II riverine wetland with a 110 foot buffer, located in the natural 100-year floodplain of May Creek. The wetland has been degraded over the years by adjacent farming and agricultural uses. Many areas of the wetland are actively mowed and used for grazing horses and other livestock. On the north side of the wetland, the wetland boundary closely follows a line of fill that appears to have been placed in wetland areas over the years to facilitate farm use. On the south side of the wetland, the wetland boundary more closely follows the natural valley topography. While fairly degraded due to adjacent land use practices, it received a Category II rating due to its high potential and opportunity to provide flood storage and improve water quality along with its moderate potential to provide habitat to a variety of species.

The hydrology source to the wetland is a combination of overbank flooding from May Creek and a high groundwater table. Numerous groundwater seeps were identified on the valley walls. The wetland is primarily palustrine emergent with some scrub-shrub/forested components that are concentrated near May Creek. The vegetation in this wetland has been degraded by the adjacent farming and agricultural uses. Many areas of the wetland are actively mowed and used for grazing, and therefore contain pasture grasses that could not be accurately identified given the season (late January) and regular mowing. In a majority of the wetland areas not regularly mowed, the dominant vegetation was reed canarygrass (*Phalaris arundinacea),* which grows in thick blankets with almost 100 percent coverage. The only unmowed areas without reed canarygrass were in the scrub-shrub/forested components of the wetland where the reed canarygrass was shaded out.

3.2.3 Geology

The wide and relatively flat May Valley (RM 3.9 to RM 7.0) was created by glacial ice melt runoff and is part of the "Kennydale Channel". The valley is underlain by recent alluvium over recessional outwash deposits and compacted glacial till. These deposits overlie Eocene Tukwila Formation. The formation is composed of volcanic tuff, fine-grained volcanic sandstone and volcanic tuff-breccia. The formation is reported to outcrop west of 146th and forms a physical boundary between the downstream ravine and May Valley upstream. The creek gradient within May Valley is 0.2 percent and the valley is predominately a depositional environment. Aerial photography and Lidar image of the valley show evidence of pre-dredging channel meanders. Historic survey mapping from 1872 show May Creek as a meandering stream and Tributary 0291a extending north to join May Creek just south of Indian Meadows rather than the current confluence approximately 1440 feet west of 164th Ave SE. The alluvial fans from Indian Meadows and Long Marsh Creeks appear on the 1872 map and the mapped location of May Creek is routed to the southwest around the higher elevations of the Long Marsh/Indian Meadows alluvial fans. The historic channel map for 0291a is consistent with Lidar images showing meander scars in the valley.

4 EFFECTS OF ACTION

4.1 Direct Effects

No direct effect on listed species will occur because these species are not present at the project location. Direct effects are analyzed below in Section 6 for the essential fish habitat consultation.

4.2 Indirect Effects

Indirect effects are those impacts that are caused by the action and occur later in time (after the action is completed) but are still reasonably certain to occur. Indirect effects from modification of May Creek and Long Marsh Creek will result in long-term habitat alterations. These effects include temporary increases is stream temperature from riparian clearing and modification to sediment transport.

A technical memo prepared by King County to assess sediment conditions in May Creek is provided in Appendix B and summarized below. The project proposes a number of features to reduce sedimentation to May Creek and channel filling. These include native plant buffers along the banks, removal and control of reed canarygrass, reduced overbank flooding, selected removal of vegetation from the channel downstream of 148th Ave SE, and a sediment management design for Long Marsh Creek. These features are expected to produce the following effects:

- Adding plant buffers on either side of May Creek will locally reduce the amount of sediment reaching May Creek from rainfall runoff. Where reed canarygrass is present above the channel slopes, the grass is effective at catching and trapping sediment.
- Removal and control of reed canarygrass will slow channel narrowing and infilling due to growth during spring and summer during low flows.
- Reducing over bank flooding of pastures will reduce the amount of sediment and organic material being carried to the creek by an estimated 0.21 to 0.84 metric tons per year.
- Improved channel hydraulic efficiency will improve and move fine sediment and organic material that reaches the creek downstream, reducing the amount of sediment trapped in reed canary grass above 148th Ave SE.
- The proposed alcove excavation and planting areas west of 148th Ave will allow the creek to overflow into the alcoves during higher flows, this will slow the current velocities allowing sediment to drop out of suspension, but the actual amount of deposition is unknown.
- The May Creek channel is likely to be both a depositional area and a source of suspended sediment during higher flows. Soft muck in the stream bottom above the confluence with Long Marsh Creek is a combination of organic material from pasture runoff with mineral sediment. The muck builds up in the channel after rain storms

- A mitigation project in Long Marsh Creek will intercept gravel and large sand size sediment before it reaches May Creek.
- Following bank stabilization with jute netting and seeding will reduce erosion and sediment input to May Creek.

The May Creek Current and Future Conditions report (King County, 1995) identified the major sources of sediment to May Creek as coming from the ravine and tributaries below May Valley. The hydraulic analysis (King County, 2010a) shows that changes in flow velocity below 143rd Ave SE will be negligible. Sediment movement is controlled by flow. Therefore, the same size sediments would be moved within the May Creek system. We estimate the project related reductions in sediment delivered to the creek primarily from reduced overbank flooding, will reduce the total fine sediment and organic muck in the stream. In general, fine sediment that does enter the creek as bedload or suspended sediment will move downstream due to improved channel efficiency rather than being stored in the creek channel above 148th, incorporated into the banks or moving though during large flow events. Some fine sediment or muck entering the creek will continue to be stored behind topographic highs and lows in the channel above and below 148^{th} Ave.

At issue are the potential indirect effects of exposing adult, juvenile, and embryonic Chinook salmon to degraded water quality associated with sedimentation. Project activities will result in the removal of channel sediment and existing vegetation. Temporary impacts include sedimentation, loss of shade, and loss of organic detritus recruitment. Permanent beneficial effects include a net reduction in sedimentation and establishment of a riparian buffer planted with woody vegetation.

Sedimentation and turbidity from land use activities can degrade salmonid habitat (Bash et al., 2001). Other impacts associated with elevated turbidity levels include behavioral modification, gill trauma, increased stress, reduced osmoregulation, modification of blood chemistry, reduced growth, reduced forage success, higher predation, redd damage, and lower reproduction. High levels of suspended solids may be fatal to salmonids, while lower levels may cause chronic sub-lethal effects (Lloyd et al., 1987). Juveniles and eggs appear to be more sensitive to sedimentation and turbidity than do adults (Lloyd et al., 1987).

Sedimentation and turbidity are normal occurrences in natural streams and can periodically reach relatively high levels. Depending on the time of year and location of the sediment discharge, increased turbidity could negatively affect an individual's ability to forage, seek shelter, and access cold-water refuge. The size of the sediment particles and flow velocities can affect the duration of sediment suspension in the water column. Larger particles (> 2mm), such as sand and gravel, typically settle rapidly, but silt and very fine sediment may be suspended for several hours. Suspended solids can potentially reduce light transmission and, if chronic, may suppress primary production negatively affecting the feeding success of juvenile Chinook. Sediment and turbidity also have the potential to modify adult migration and spawning. Limiting the in-water work to approved construction windows when few, if any, Chinook are present and the implementation, maintenance and monitoring of appropriate BMPs to reduce the risk of discharges of fine sediments will limit any potential impacts to Chinook.

Physical removal of muck (fine sediment) within the channel, maintaining topographic controls (i.e. bridge at 148th), creating off-channel alcoves for deposition, and establishing riparian buffer with woody vegetation will reduce or eliminate the potential to introduce fine sediment into water containing listed species. By taking these protective measures it is unlikely that any life stage of Chinook will be negatively impacted by sediment discharges from this project. Additionally, effects on steelhead are expected to be similar to those described above for Chinook.

4.3 Effects from Interrelated and Interdependent Actions

An interdependent activity is an activity that has no independent utility apart from the proposed action. An interrelated activity is an action that is part of a larger action and depends on the larger action for its justification. No interrelated or interdependent actions will occur as a result of the proposed project action for Chinook, steelhead, or bull trout.

5 CONCLUSIONS

The determination of effects for protected fish species is contingent upon implementation of the previously identified impact minimization measures and mitigation. The proposed action may have the following impacts on Chinook and steelhead trout (Table 3):

1) Modifications in sediment transport described in chapter 4.2 have the potential to indirectly impact fish within the project action area.

    - Preliminary assessments of sediment loading (Appendix B) indicate a net reduction in sediment loading resulting from the project
    - While some topographic controls will remain in place, removal of channel obstructions will allow sediment to pulse through during smaller flow events.

2) Temporary removal of riparian vegetation has the potential to indirectly disturb or harm fish within the project action area.

    - Temporary clearing of riparian vegetation will result in elevated summer stream temperatures. Based on post construction monitoring of similar activities, we anticipate elevated stream temperatures for approximately five years.

Considering the information referenced in this report and project information provided in the construction plans, an effect determination of **may affect** is appropriate for Chinook and steelhead trout because:

- Chinook presence has recently been documented downstream of the project within the action area.
- Steelhead presence has historically been documented downstream of the project within the action area

The project is **not likely to adversely affect** these species because:

- The project is proposed to occur during the designated in-water work window (August1-31) when species, primarily Chinook, are least likely to be present.
- These species are not present at the project location where direct impacts would occur.
- Short-term water quality effects to listed species resulting from rewatering of the newly excavated channel will be discountable or insignificant.
- Long-term water quality effects to listed species resulting from net reductions in sediment loading will be insignificant.
- Short-term effects to species from elevated stream temperatures resulting from riparian clearing will be discountable and/or insignificant.

- Permanent beneficial effects from mitigation elements will result in riparian, in-stream, and wetland improvements.
- Potential impacts described above will be reduced through impact avoidance and minimization measures.

Table 3: Summary of Project Effects on Species Protected Under the ESA

Species	Federal Status	Life Stages Considered	Effect Determinations
Chinook Salmon *(Oncorhynchus tshawytscha*)	Threatened	All freshwater phases	May affect, not likely to adversely affect
Steelhead Trout *(O. mykiss)*	Threatened	All freshwater phases	May affect, not likely to adversely affect
Essential Fish Habitat		May Creek	Will adversely effect

6 MAGNUSON STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Action Agency: King County Department of Natural Resources and Parks

Project Name: May Creek Drainage Improvement Project (9A1205)

6.1 Essential Fish Habitat Background

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires federal agencies to consult with NOAA Fisheries on activities that may adversely affect essential fish habitat (EFH).

The objective of this EFH assessment is to determine whether or not the proposed action(s) “may adversely affect” designated EFH for relevant commercially, federally-managed fisheries species within the proposed action area. It also describes conservation measures proposed to avoid, minimize, or otherwise offset potential adverse effects to designated EFH resulting from the proposed action.

Pacific Coast Salmon

NMFS has designated EFH for Pacific Coast salmon, including Chinook, coho and pink salmon, in Amendment 14 to the Pacific Coast Salmon Plan (NMFS 2000a). Within the action area, May Creek and Long Marsh Creek contain EFH for species present (Chinook and coho salmon). The Pacific salmon fishery EFH includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except above the impassable barriers identified by the PFMC (1999). Construction projects can significantly alter land surface, soil, vegetation, and hydrology, and can adversely impact salmon EFH through habitat loss or modification. Among numerous types of non-fishing activities that may affect EFH, should BMPs fail, those applicable to the action area are those that will:

- Alter sediment delivery to, and quantity in, streams and estuaries;
- Alter water flow, quantity, timing, or temperature;
- Alter the amount or types of nutrients or prey.
- Discharge pollutants, nutrients, or contaminants.

6.2 Description of the Proposed Action

The proposed action, environmental baseline, and action area are described in Chapter 1.2, Description of Proposed Project Action; Chapter 1.4, Action Area; and Chapter 3, Environmental Setting of this BE. The action area includes Chinook and coho rearing and spawning habitat. Proposed project actions include:

- Clearing, grubbing, grading, and dredging;
- Work area isolation via stream bypass;
- Habitat enhancement and creation, and site restoration;
- Landscaping and planting.

6.3 Adverse Effects Essential Fish Habitat for Salmonids

The determination of the effects of the proposed project on EFH is based on Section 305(b)(2) of the Magnuson-Stevens Act. Under this act, federal agencies are required to consult with NMFS regarding any of their actions or proposed actions authorized, funded, or undertaken that may "adversely affect" EFH. "Adverse effect" means any impact which reduces the quality and/or quantity of EFH. This can include direct (e.g., contamination, physical disruption), indirect (e.g., loss of prey, reduction in species' fecundity), site-specific, and habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

Project effects to ESA listed species are described in Section 4 and will also apply to coho in May Creek. In addition to those indirect effects, coho are present at the project location and will be directly impacted by the project action. Adverse effects from dredging of 2,000 linear feet of channel will result from an alteration in availability and quality of migration/rearing habitat for coho salmon in May Creek. Strict adherence to BMPs (see Section 1.3) will minimize impacts to water quality in May Creek during project construction and proposed mitigation is designed to offset the operational impacts. Overall, there will be direct (coho) and indirect (coho and Chinook) effects upon Pacific Coast salmon EFH during project construction, but the proposed conservation measures and project BMPs will limit the scope and scale of the impacts, and no large-scale deleterious effects are expected to occur.

6.4 Essential Fish Habitat Conservation Measures

Conservation measures will be implemented to minimize the potential adverse effects on designated EFH are described in Chapter 1.3

6.5 Conclusions

Based on the EFH requirements of Pacific Coast salmon species, BMPs, and conservation measures proposed as part of the project, the determination is that the project ***will adversely affect*** EFH for coho salmon.

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Appendix A

Species Lists

Endangered Species Act Status of West Coast Salmon & Steelhead

(Updated July 1, 2009)

Species[1]			*Current Endangered Species Act Listing Status[2]*	*ESA Listing Actions Under Review*
Sockeye Salmon (*Oncorhynchus nerka*)	1	Snake River	*Endangered*	
	2	Ozette Lake	*Threatened*	
	3	Baker River	*Not Warranted*	
	4	Okanogan River	*Not Warranted*	
	5	Lake Wenatchee	*Not Warranted*	
	6	Quinalt Lake	*Not Warranted*	
	7	Lake Pleasant	*Not Warranted*	
Chinook Salmon (*O. tshawytscha*)	8	Sacramento River Winter-run	*Endangered*	
	9	Upper Columbia River Spring-run	*Endangered*	
	10	Snake River Spring/Summer-run	*Threatened*	
	11	Snake River Fall-run	*Threatened*	
	12	Puget Sound	*Threatened*	
	13	Lower Columbia River	*Threatened*	
	14	Upper Willamette River	*Threatened*	
	15	Central Valley Spring-run	*Threatened*	
	16	California Coastal	*Threatened*	
	17	Central Valley Fall and Late Fall-run	*Species of Concern*	
	18	Upper Klamath-Trinity Rivers	*Not Warranted*	
	19	Oregon Coast	*Not Warranted*	
	20	Washington Coast	*Not Warranted*	
	21	Middle Columbia River spring-run	*Not Warranted*	
	22	Upper Columbia River summer/fall-run	*Not Warranted*	
	23	Southern Oregon and Northern California Coast	*Not Warranted*	
	24	Deschutes River summer/fall-run	*Not Warranted*	
Coho Salmon (*O. kisutch*)	25	Central California Coast	*Endangered*	
	26	Southern Oregon/Northern California	*Threatened*	
	27	Lower Columbia River	*Threatened*	• Critical habitat
	28	Oregon Coast	*Threatened*	
	29	Southwest Washington	*Undetermined*	
	30	Puget Sound/Strait of Georgia	*Species of Concern*	
	31	Olympic Peninsula	*Not Warranted*	
Chum Salmon (*O. keta*)	32	Hood Canal Summer-run	*Threatened*	
	33	Columbia River	*Threatened*	
	34	Puget Sound/Strait of Georgia	*Not Warranted*	
	35	Pacific Coast	*Not Warranted*	
Steelhead (*O. mykiss*)	36	Southern California	*Endangered*	
	37	Upper Columbia River	*Threatened*	
	38	Central California Coast	*Threatened*	
	39	South Central California Coast	*Threatened*	
	40	Snake River Basin	*Threatened*	
	41	Lower Columbia River	*Threatened*	
	42	California Central Valley	*Threatened*	
	43	Upper Willamette River	*Threatened*	
	44	Middle Columbia River	*Threatened*	
	45	Northern California	*Threatened*	
	46	Oregon Coast	*Species of Concern*	
	47	Southwest Washington	*Not Warranted*	
	48	Olympic Peninsula	*Not Warranted*	
	49	Puget Sound	*Threatened*	• Critical habitat
	50	Klamath Mountains Province	*Not Warranted*	
Pink Salmon (*O. gorbuscha*)	51	Even-year	*Not Warranted*	
	52	Odd-year	*Not Warranted*	

1 The ESA defines a "species" to include any distinct population segment of any species of vertebrate fish or wildlife. For Pacific salmon, NOAA Fisheries Service considers an evolutionarily significant unit, or "ESU," a "species" under the ESA. For Pacific steelhead, NOAA Fisheries Service has delineated distinct population segments (DPSs) for consideration as "species" under the ESA.

The project is located in T23N R05E S02 & S03.

Sections that Contain Natural Heritage Features

Data Current as of November 5, 2010

List of surveyed land sections in Washington identified by the Natural Heritage Program as reported to contain Natural Heritage Features. Contact the Washington Natural Heritage Program at (360) 902-1667 for more detailed information on locations and occurrences.

Town. Range Sec.	Town. Range Sec.	Town. Range Sec.	Town. Range Sec.
T22N R35E S13	T23N R02W S14	T23N R09W S19	T23N R17E S04
T22N R35E S23	T23N R02W S15	T23N R09W S20	T23N R17E S12
T22N R35E S24	T23N R02W S16	T23N R09W S21	T23N R17E S13
T22N R35E S29	T23N R02W S17	T23N R09W S26	T23N R17E S27
T22N R35E S30	T23N R02W S20	T23N R09W S29	T23N R18E S07
T22N R35E S31	T23N R02W S21	T23N R09W S30	T23N R18E S08
T22N R35E S32	T23N R02W S22	T23N R09W S31	T23N R18E S16
T22N R35E S33	T23N R03W S03	T23N R09W S32	T23N R18E S17
T22N R36E S04	T23N R03W S04	T23N R09W S38	T23N R18E S18
T22N R37E S26	T23N R03W S09	T23N R09W S40	T23N R18E S19
T22N R39E S19	T23N R03W S10	T23N R09W S50	T23N R18E S20
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T23N R01W S32	T23N R09W S07	T23N R17E S01	T23N R22E S28
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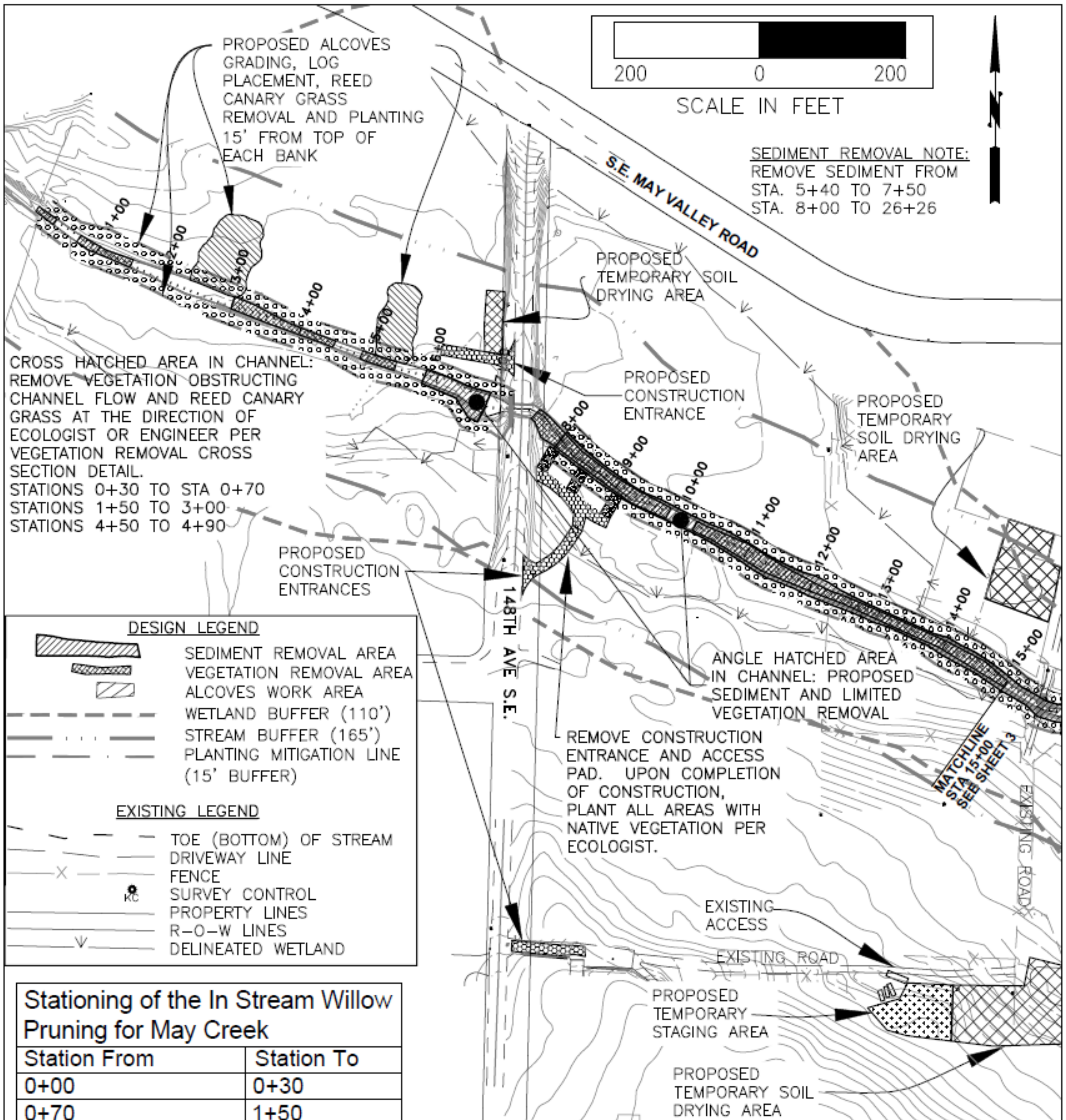
Appendix B

May Creek Drainage Improvement Project- Plan Sheets



Stationing of the In Stream Willow Pruning for May Creek

Station From	Station To
0+00	0+30
0+70	1+50
3+00	4+50
4+90	5+40
7+50	9+80
10+20	15+00

THE EXISTING TOPOGRAPHIC AND PHYSICAL FEATURES SHOWN ON THIS PLAN ARE BASED ON A COMBINATION OF FIELD OBSERVATIONS AND LAND SURVEY

King County

PURPOSE: REDUCE DURATION OF FLOODING ON PROPERTIES ADJACENT TO MAY CREEK; BETWEEN APPROX. RIVER MILE 4.3 AND 4.9.

DIRECTIONS TO SITE: FROM COAL CREEK PARKWAY, (EAST OF I-405) TURN EAST ON S.E. MAY VALLEY ROAD. GO TO 148TH AVE S.E., TURN SOUTH TO BRIDGE OVER MAY CREEK.

DATUM: WASHING STATE LAMBERT GRID NORTH ZONE; NAD 83 / 91; NAVD 88

PROJECT TITLE: MAY CREEK DRAINAGE IMPROVEMENT

SHEET TITLE: PLAN VIEW STA. 0+00 – 15+00

SCALE: 1" = 200'

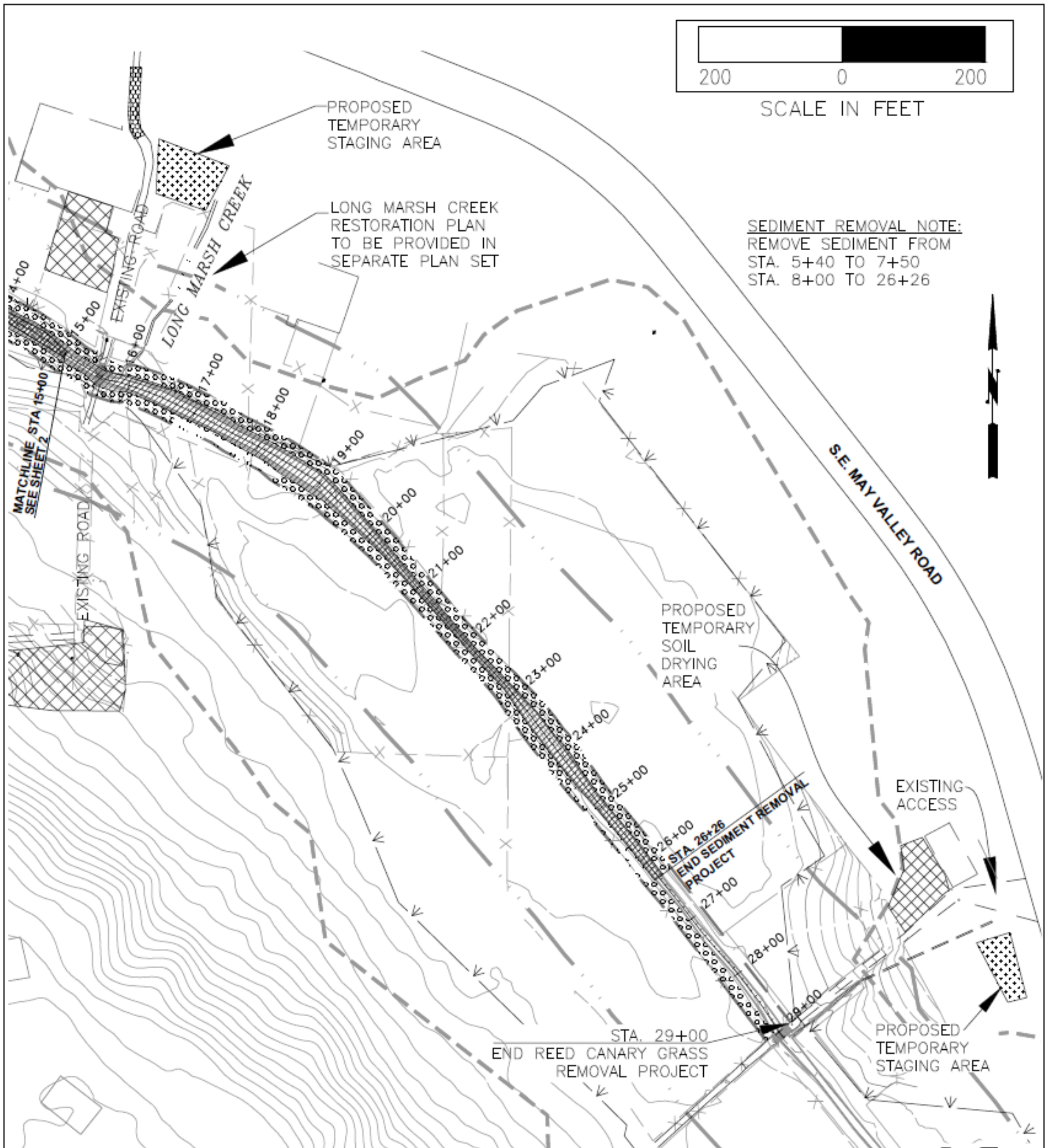
ASSISTANCE BY: LINDSEY MILLER

DRAWN BY: MEREDITH RADELLA

PROPOSED WORK: REMOVE FLOW OBSTRUCTING VEGETATION AND SEDIMENT FROM MAY CREEK. PLANT 15' BUFFER OF NATIVE VEGETATION ON BOTH SIDES OF CHANNEL. ENHANCE OFF-CHANNEL WETLAND FISH HABITAT DOWNSTREAM OF 148TH AVE S.E.

SHEET: 2 OF 8

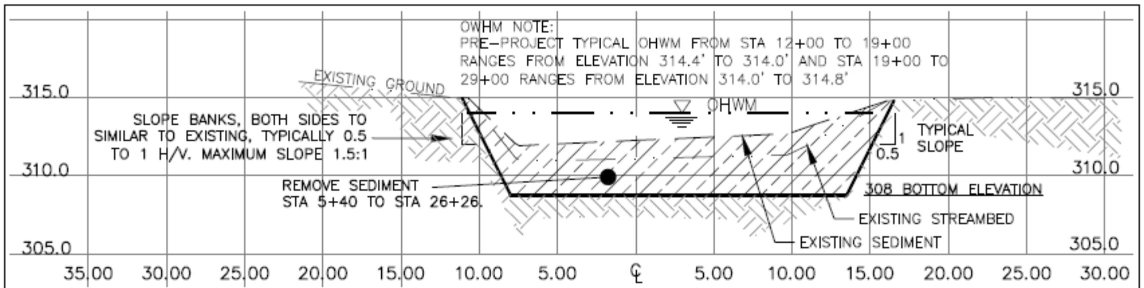
DATE: FEB 3, 2011



THE EXISTING TOPOGRAPHIC AND PHYSICAL FEATURES SHOWN ON THIS PLAN ARE BASED ON A COMBINATION OF FIELD OBSERVATIONS AND LAND SURVEY

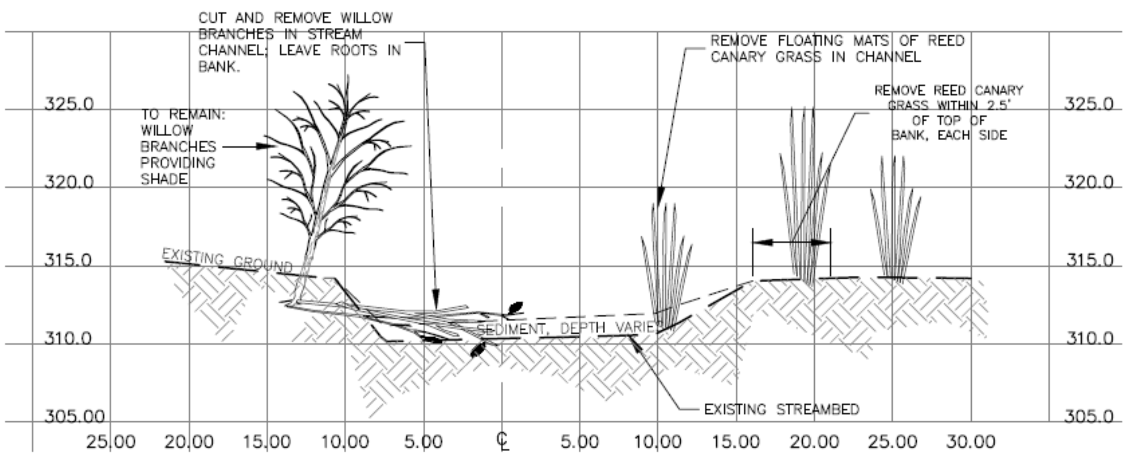
King County

PURPOSE: REDUCE DURATION OF FLOODING ON PROPERTIES ADJACENT TO MAY CREEK; BETWEEN APPROX. RIVER MILE 4.3 AND 4.9.	PROJECT TITLE: MAY CREEK DRAINAGE IMPROVEMENT	PROPOSED WORK: REMOVE FLOW OBSTRUCTING VEGETATION AND SEDIMENT FROM MAY CREEK. PLANT 15' BUFFER OF NATIVE VEGETATION ON BOTH SIDES OF CHANNEL. ENHANCE OFF–CHANNEL WETLAND FISH HABITAT DOWNSTREAM OF 148TH AVE S.E.
DIRECTIONS TO SITE: FROM COAL CREEK PARKWAY, (EAST OF I–405) TURN EAST ON S.E. MAY VALLEY ROAD. GO TO 148TH AVE S.E., TURN SOUTH TO BRIDGE OVER MAY CREEK.	SHEET TITLE: PLAN VIEW STA. 15+00 – 29+00	
DATUM: WASHING STATE LAMBERT GRID NORTH ZONE; NAD 83 / 91; NAVD 88	SCALE: 1" = 200' ASSISTANCE BY: LINDSEY MILLER DRAWN BY: MEREDITH RADELLA	SHEET: 3 OF 8 DATE: FEB 3, 2011



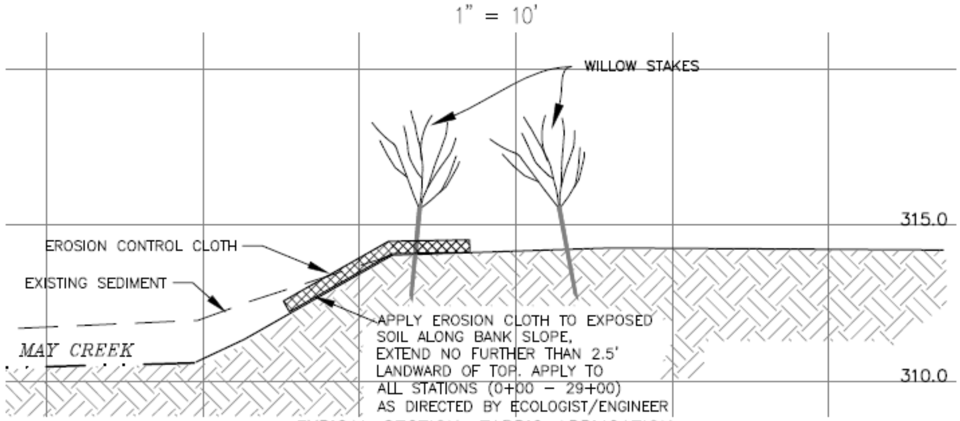
TYPICAL SECTION: SEDIMENT REMOVAL

1" = 10'



TYPICAL SECTION: VEGETATION REMOVAL

1" = 10'

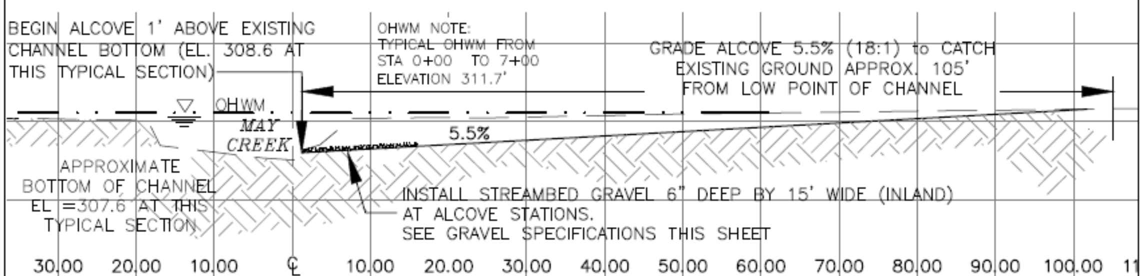


TYPICAL SECTION: FABRIC APPLICATION

1" = 5'

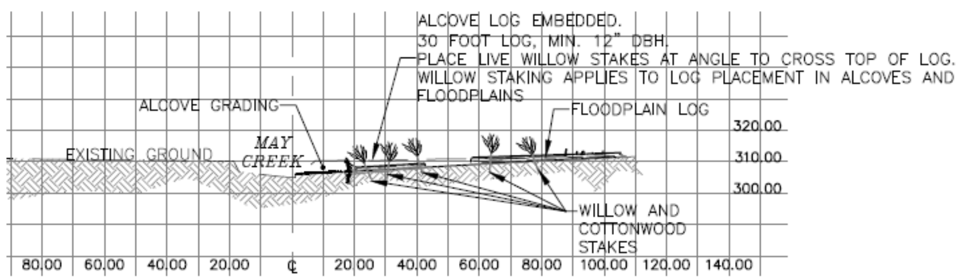
King County

PURPOSE: REDUCE DURATION OF FLOODING ON PROPERTIES ADJACENT TO MAY CREEK; BETWEEN APPROX. RIVER MILE 4.3 AND 4.9. DIRECTIONS TO SITE: FROM COAL CREEK PARKWAY, (EAST OF I–405) TURN EAST ON S.E. MAY VALLEY ROAD. GO TO 148TH AVE S.E., TURN SOUTH TO BRIDGE OVER MAY CREEK. DATUM: AS STATED	PROJECT TITLE: MAY CREEK DRAINAGE IMPROVEMENT SHEET TITLE: SECTION VIEWS SCALE: NOT TO SCALE ASSISTANCE BY: LINDSEY MILLER DRAWN BY: MEREDITH RADELLA	PROPOSED WORK: REMOVE FLOW OBSTRUCTING VEGETATION AND SEDIMENT FROM MAY CREEK. PLANT 15' BUFFER OF NATIVE VEGETATION ON BOTH SIDES OF CHANNEL. ENHANCE OFF–CHANNEL WETLAND FISH HABITAT DOWNSTREAM OF 148TH AVE S.E. SHEET: 4 OF 8 DATE: FEB 3, 2011



HABITAT MITIGATION ALCOVE GRADING

1" = 20'



HABITAT LOG MITIGATION PLACEMENT

1" = 50'

LWD INSTALLATION NOTES:
THE FOLLOWING METHODS OR COMBINATIONS THEREOF WILL BE USED TO REDUCE MOBILITY OF LWD:

- EMBEDMENT OF 50 PERCENT SURFACE AREA OF LOGS AND WILLOW ANCHOR POLES
- TRENCH/BURY 60 PERCENT OF LOG LENGTH
- PINNING OF LOGS AND ROOTWADS BEHIND EXISTING TREES GREATER THAN 12" DIAMETER IN COMBINATION WITH PARTIAL TRENCHING OF LOG

King County

PURPOSE: REDUCE DURATION OF FLOODING ON PROPERTIES ADJACENT TO MAY CREEK; BETWEEN APPROX. RIVER MILE 4.3 AND 4.9. DIRECTIONS TO SITE: FROM COAL CREEK PARKWAY, (EAST OF I–405) TURN EAST ON S.E. MAY VALLEY ROAD. GO TO 148TH AVE S.E., TURN SOUTH TO BRIDGE OVER MAY CREEK. DATUM: AS STATED	PROJECT TITLE: MAY CREEK DRAINAGE IMPROVEMENT SHEET TITLE: SECTION VIEWS SCALE: NOT TO SCALE ASSISTANCE BY: LINDSEY MILLER DRAWN BY: MEREDITH RADELLA	PROPOSED WORK: REMOVE FLOW OBSTRUCTING VEGETATION AND SEDIMENT FROM MAY CREEK. PLANT 15' BUFFER OF NATIVE VEGETATION ON BOTH SIDES OF CHANNEL. ENHANCE OFF–CHANNEL WETLAND FISH HABITAT DOWNSTREAM OF 148TH AVE S.E. SHEET: 5 OF 8 DATE: FEB 3, 2011

MITIGATION PLAN NOTES CONTINUED

(B) PLANTING NOTES

1. MITIGATION PLANTING PLANS REPRESENT A CONCEPTUAL PLANT LAYOUT. ALL MITIGATION PLANTING PREPARATION WILL BE DIRECTED IN THE FIELD BY THE ECOLOGIST.
2. PLANTING SHALL TAKE PLACE DURING THE DORMANT SEASON (NOVEMBER 1ST THROUGH FEBRUARY 28TH). PLANTING MAY BE ALLOWED AT OTHER TIMES AFTER REVIEW AND WRITTEN APPROVAL BY THE ECOLOGIST.
3. WITHIN THE FLOODPLAIN EXCAVATION AREAS AND ALL PLANTING AREAS WHERE REED CANARY GRASS HAS BEEN COMPLETELY REMOVED, PROVIDE AND INSTALL 4 INCHES OF COMPOST (PER SPEC) ROTOTILLED TO A (12) INCH MINIMUM.
4. IN ALL PLANTING AREAS WHERE REED CANARY GRASS IS PRESENT, FIRST MOW THE GRASS. COVER MOWED REED CANARYGRASS WITH CARDBOARD (OR A SIMILAR BARRIER MATERIAL AS APPROVED BY THE ECOLOGIST) FOLLOWED BY 6 INCHES OF COMPOST.
5. PLANT SHRUBS AND TREES THROUGH THE CARDBOARD AND COMPOST AS DIRECTED BY THE ECOLOGIST.
6. ALL PLANTS SHALL BE NURSERY GROWN A MINIMUM OF ONE YEAR. PLANT MATERIAL IS TO BE SUPPLIED BY COMMERCIAL NURSERIES THAT SPECIALIZE IN PLANTS NATIVE TO THE PACIFIC NORTHWEST. PLANT MATERIAL SUBSTITUTIONS ARE SUBJECT TO APPROVAL BY THE ECOLOGIST.
7. NO TACKIFIER, HERBICIDE, OR FERTILIZER SHALL BE USED IN THE PLANTING AREAS.

(C) GENERAL NOTES

1. TO PREVENT REESTABLISHMENT OF INVASIVE VEGETATION, THE TOP 24 INCHES OF EXCAVATED SOIL IS NOT TO BE REUSED AS FILL ANYWHERE ON THE PROJECT SITE.
2. DO NOT DRIVE EQUIPMENT IN AREAS OF THE SITE WHERE COMPOST HAS BEEN MIXED INTO THE NATIVE SOIL.

May Creek Riparian Buffer Planting, west & east of 148th Ave SE

Latin Name	Common Name	Size/Specifications	Quantity
Trees			
Alnus rubra	Red alder	1" Caliper @ 6–8' Height Plant 9' O.C.	260
Picea sitchensis	Sitka spruce	5 gal., 5–6' Height Full Dense Foliage Plant 9' O.C.	260
Populus balsamifera spp. trichocarpa	Black cottonwood	6' stake, top on, 1" diameter Plant 9' O.C.	260
Thuja pliclata	Western red cedar	5 gal., 5–6' Height Full Dense Foliage Plant 9' O.C.	260
Shrubs/Willows			
Cornus sericea	Red–oiser dogwood	Bare root, Minimum 36" Long Plant 3' O.C.	590
Salix lasiandra	Pacific willow	Live Stakes, 6' Long, 1/2–1" Diameter Plant 3' O.C.	690
Salix sitchensis	Sitka willow	Live Stakes, 6' Long, 1/2–1" Diameter Plant 3' O.C.	690

King County

PURPOSE: REDUCE DURATION OF FLOODING ON PROPERTIES ADJACENT TO MAY CREEK; BETWEEN APPROX. RIVER MILE 4.3 AND 4.9. DIRECTIONS TO SITE: FROM COAL CREEK PARKWAY, (EAST OF I–405) TURN EAST ON S.E. MAY VALLEY ROAD. GO TO 148TH AVE S.E., TURN SOUTH TO BRIDGE OVER MAY CREEK. DATUM: AS STATED	PROJECT TITLE: MAY CREEK DRAINAGE IMPROVEMENT SHEET TITLE: PLANTING NOTES AND TABLE SCALE: NOT TO SCALE ASSISTANCE BY: LINDSEY MILLER DRAWN BY: MEREDITH RADELLA	PROPOSED WORK: REMOVE FLOW OBSTRUCTING VEGETATION AND SEDIMENT FROM MAY CREEK. PLANT 15' BUFFER OF NATIVE VEGETATION ON BOTH SIDES OF CHANNEL. ENHANCE OFF–CHANNEL WETLAND FISH HABITAT DOWNSTREAM OF 148TH AVE S.E. SHEET: 7 OF 8 DATE: FEB 3, 2011

May Creek Alcoves & Wetland Enhancement Planting Plan - west of 148th Avenue SE

Latin Name	Common Name	Size/Specifications	Quantity
Emergents - for alcoves near stream			
Juncus effusus	Common rush	Plug (Plant 12" O.C.)	500
Eleocharis palustris	Creeping spike-rush	Plug (Plant 12" O.C.)	500
Carex stipata	Sawbeak sedge	Plug (Plant 12" O.C.)	500
Shrubs/Willows			
Cornus sericea	Red-oiser dogwood	Bare root, mi. 3' long Plant 3' O.C.	125
Physocarpus capitatus	Pacific ninebark	Bare root, mi. 3' long Plant 3' O.C.	100
Rosa pisocarpa	Swamp rose	Bare root, mi. 3' long Plant 3' O.C.	175
Spiraea douglasii	Douglas Spirea	Bare root, mi. 3' long Plant 3' O.C.	175
Rubus spectabilis	Salmonberry	Bare root, mi. 3' long Plant 3' O.C.	150
Salix lasiandra	Pacific willow	Live Stakes Minimum 6' Long 3/4–1" Diameter Plant 2' O.C.	300
Salix sitchensis	Sitka willow	Live Stakes Minimum 6' Long 3/4–1" Diameter Plant 2' O.C.	300
Salix lasiandra	Pacific willow	Live stakes Minimum 6' long Minimum 3/4" –1" diameter	250
Populus trichocarpa	Black Cottonwood	Live pole cutting Minimum 6' long Minimum 3/4"–1" diameter	250

King County

PURPOSE: REDUCE DURATION OF FLOODING ON PROPERTIES ADJACENT TO MAY CREEK; BETWEEN APPROX. RIVER MILE 4.3 AND 4.9.

DIRECTIONS TO SITE: FROM COAL CREEK PARKWAY, (EAST OF I–405) TURN EAST ON S.E. MAY VALLEY ROAD. GO TO 148TH AVE S.E., TURN SOUTH TO BRIDGE OVER MAY CREEK.

DATUM: AS STATED

PROJECT TITLE: MAY CREEK DRAINAGE IMPROVEMENT

SHEET TITLE: LOG AND PLANTING TABLES

SCALE: NOT TO SCALE

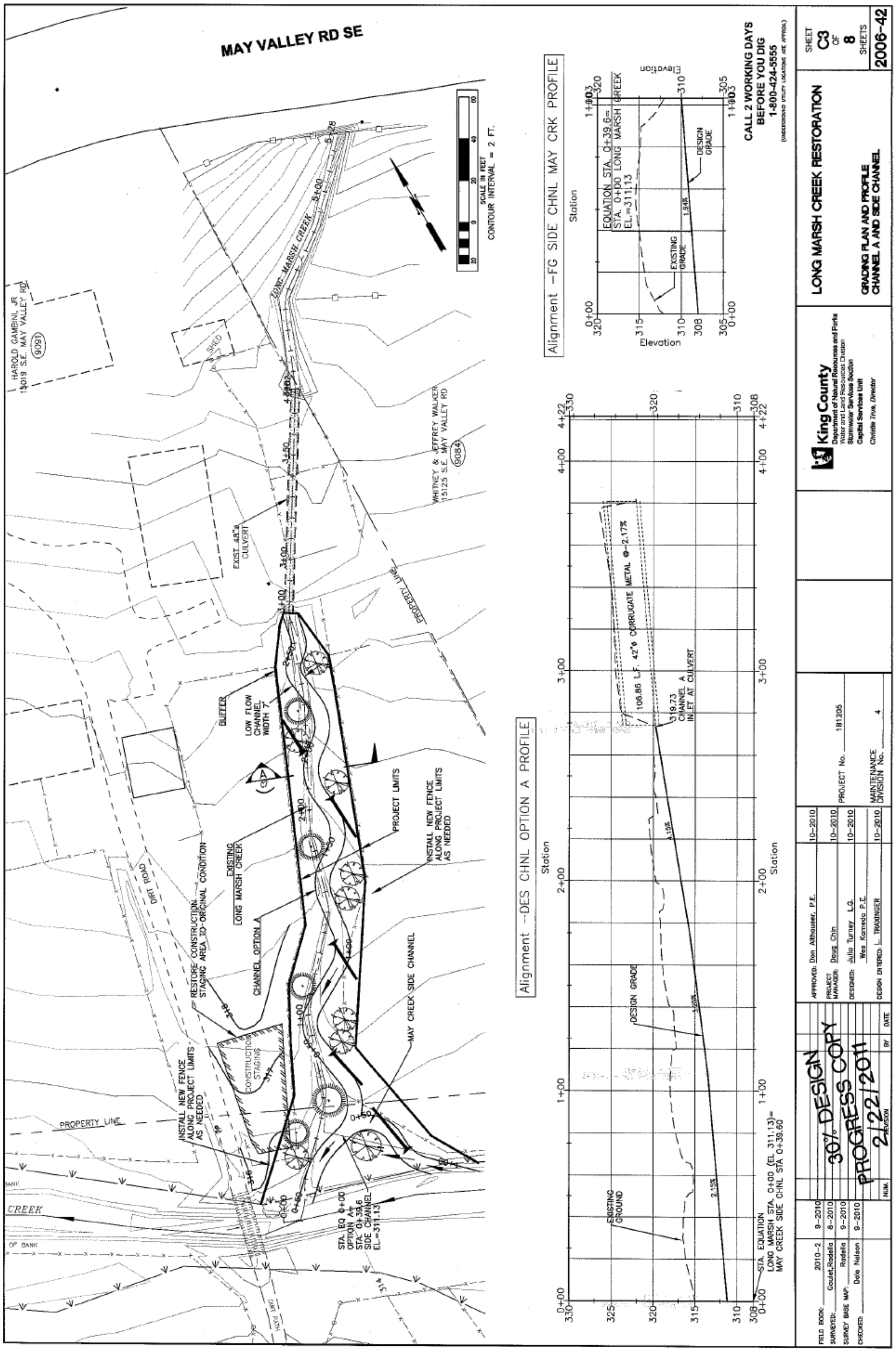
ASSISTANCE BY: LINDSEY MILLER

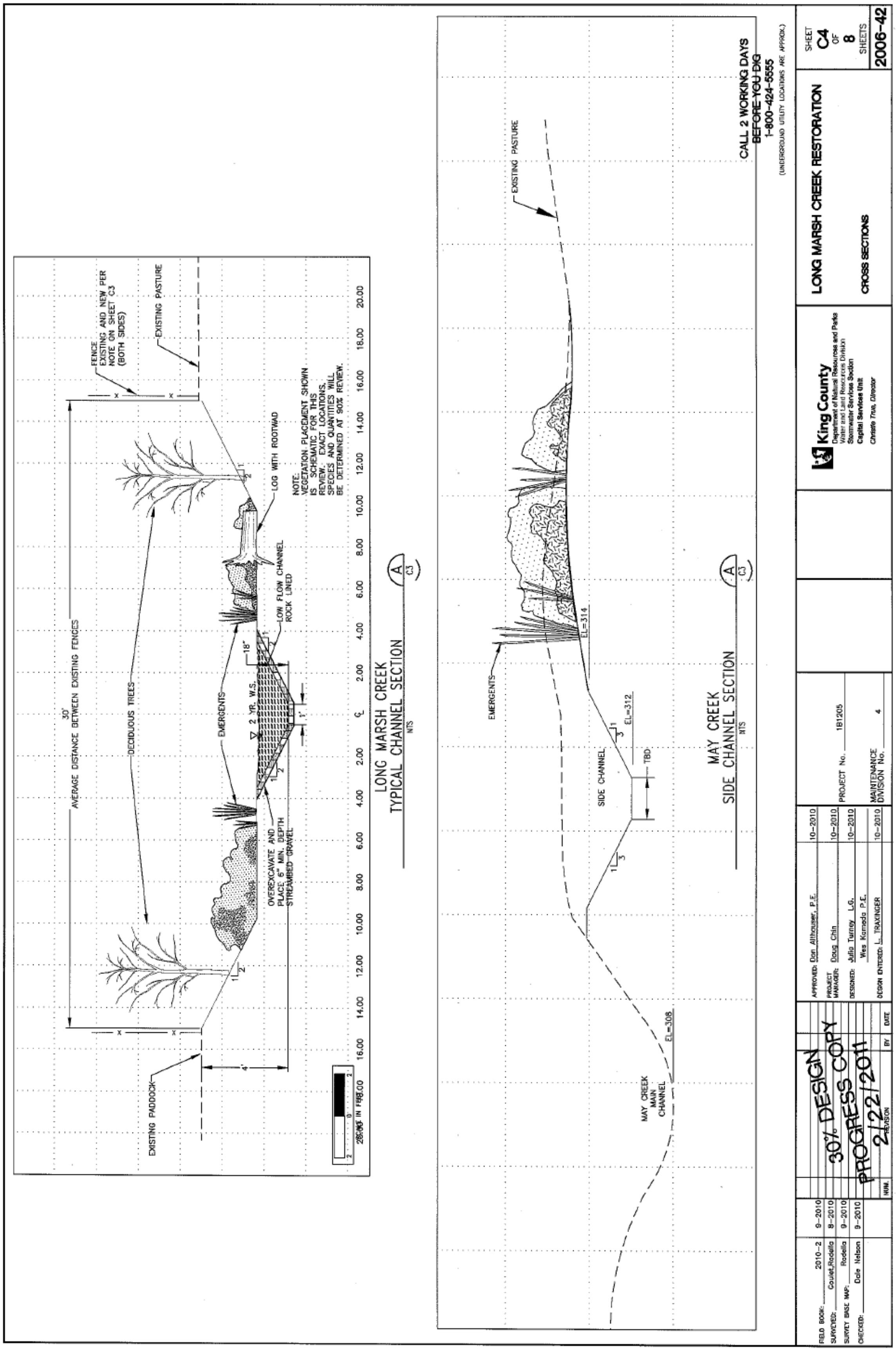
DRAWN BY: MEREDITH RADELLA

PROPOSED WORK: REMOVE FLOW OBSTRUCTING VEGETATION AND SEDIMENT FROM MAY CREEK. PLANT 15' BUFFER OF NATIVE VEGETATION ON BOTH SIDES OF CHANNEL. ENHANCE OFF–CHANNEL WETLAND FISH HABITAT DOWNSTREAM OF 148TH AVE S.E.

SHEET: 8 OF 8

DATE: FEB 3, 2011


MAY VALLEY RD SE
Alignment -FG SIDE CHNL MAY CRK PROFILE
Alignment -DES CHNL OPTION A PROFILE
CALL 2 WORKING DAYS BEFORE YOU DIG 1-800-424-5555
LONG MARSH CREEK RESTORATION
GRADING PLAN AND PROFILE CHANNEL A AND SIDE CHANNEL
King County
30% DESIGN PROGRESS COPY
2/22/2011
SHEET C3 OF 8 SHEETS
2006-42


LONG MARSH CREEK
TYPICAL CHANNEL SECTION
NTS
MAY CREEK
SIDE CHANNEL SECTION
NTS
30' AVERAGE DISTANCE BETWEEN EXISTING FENCES
DECIDUOUS TREES
EMERGENTS
EXISTING PADDOCK
FENCE EXISTING AND NEW PER NOTE ON SHEET C3 (BOTH SIDES)
EXISTING PASTURE
LOG WITH ROOTWAD
LOW FLOW CHANNEL ROCK LINED
OVEREXCAVATE AND PLACE 6" MIN. DEPTH STREAMBED GRAVEL
2 YR. W.S.
NOTE: VEGETATION PLACEMENT SHOWN IS SCHEMATIC FOR THIS REVIEW. EXACT LOCATIONS, SPECIES AND QUANTITIES WILL BE DETERMINED AT 90% REVIEW.
SIDE CHANNEL
MAY CREEK MAIN CHANNEL
EL=314
EL=312
EL=308
TBD
CALL 2 WORKING DAYS BEFORE YOU DIG 1-800-424-5555
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)
King County
Department of Natural Resources and Parks
Water and Land Resources Division
LONG MARSH CREEK RESTORATION
CROSS SECTIONS
SHEET C4 OF 8 SHEETS
2006-42
30% DESIGN PROGRESS COPY 2/22/2011
PROJECT No. 1B1205
APPROVED: Don Althauser, P.E.
PROJECT MANAGER: Doug Chin
DESIGNED: Julie Turney L.G.
Wes Kameda P.E.
DESIGN ENTERED: L. TRAXINGER

Appendix C

May Creek Drainage Improvement Project- Sediment Assessment
(Without Appendices)

King County
Department of Transportation
Road Services Division
Engineering Services Section
Environmental Unit
King Street Center
201 South Jackson Street
Seattle, WA 98104-3856
(206) 296-6520 Fax (206) 296-0567
TTY Relay: 711
www.metrokc.gov

February 9, 2011

TO: Doug Chin, Senior Engineer, Water and Land Resources Division, Department of Natural Resources and Parks

FM: Julia Turney, L.G., Environmental Engineer, Environmental Unit, Road Services Division, Department of Transportation

and

Jeff Burkey, Hydrologist, Water and Land Resources Division, Department of Natural Resources and Parks

RE: May Creek Drainage Improvement Project: SE May Valley Road and 148th Avenue SE – Sediment Assessment

Introduction

This memo provides information on sediment conditions in May Creek from approximately 148th Avenue SE upstream to 164th Avenue SE. This evaluation addresses geomorphologic controls, sediment sources, sediment behavior in the drainage and how the project actions are likely to influence future sedimentation in May Valley. The purpose of the following background evaluation is to provide information to assist King County Department of Natural Resources and Parks, Water and Land Resources Division in the design process for a drainage improvement project in May Valley. The proposed project location is shown in Figure 1.

Two questions have been raised regarding sediment associated with the May Valley drainage improvement project:

Question 1: Will the project change sediment delivery downstream to May Creek?
Question 2: After the proposed drainage improvement project and mitigation on May Creek in May Valley, will sediment refill the May Valley project area?

May Creek Channel Restoration Project

Project Vicinity

- Study Area
- Mile Markers
- Stream
- Incorporated Areas
- Cougar Mountain Wildland Park

March 2010

King County

The information included on this map has been compiled by King County staff from a variety of sources and is subject to change without notice.
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Figure 1

PD \\Red-dwarf2\Org\Environmental\Projects\9A1205 - DNRP May Creek Restoration (Miller)\Streams\GIS

There are a number of factors that were not available for the assessment:

- The actual suspended sediment loads in May Creek in the project area, the suspended and bedloads from the tributaries and the relative contribution of sediment from different sources are not known.
- The change in sediment loading over time due to changes in land use in the basin; logging, development, agriculture and channel dredging is not known.
- All of the tributaries provide some amount of sediment to May Creek within the valley but the actual volume is not known. Long Marsh Creek delivers gravel to silt sized sediment to May Creek. A depositional area of gravel and sand is visible in May Creek. Estimates of the delivery rate for Long Marsh are made from surveyed elevation changes between a sediment-removal project in 2002 and 2010.
- Beaver dams above the project area trap sediment and release sediment periodically due to flooding or breaching.

An assessment of the sediment behavior presented here is based on published basin information, aerial photo interpretation, survey data from 1965, 1979, 1993, 2002 and 2010, a soil-loss analysis by Jeff Burkey, sediment samples from the May Creek channel, and May Creek survey records and studies conducted for the project. This assessment provides a working hypothesis about sediment movement in the valley and the basis for future investigations.

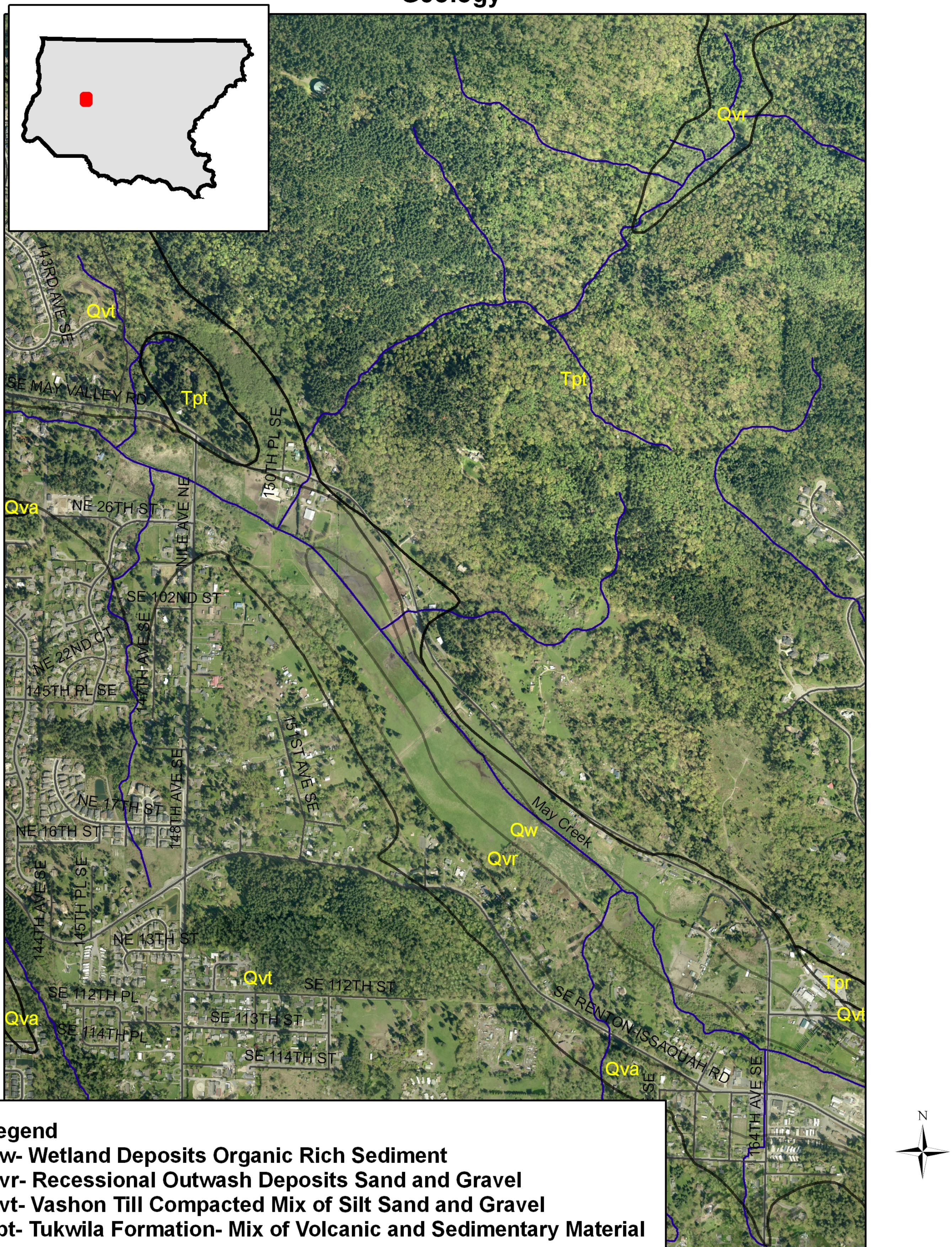
Background Geology and Stream History

The wide and relatively flat May Valley (RM 3.9 to RM 7.0) was created by glacial ice melt runoff and is part of the "Kennydale Channel". The valley is underlain by recent alluvium over recessional outwash deposits and compacted glacial till. These deposits overlie Eocene Tukwila Formation. The formation is composed of volcanic tuff, fine-grained volcanic sandstone and volcanic tuff-breccia. The formation is reported to outcrop west of 146th and forms a physical boundary between the downstream ravine and May Valley upstream. The geologic map is shown on Figure 2. The creek gradient within May Valley is 0.2 percent and the valley is predominately a depositional environment. Aerial photography and Lidar image of the valley show evidence of pre-dredging channel meanders. Historic survey mapping from 1872 shows May Creek as a meandering stream and Tributary 0291a extending north to join May Creek just south of Indian Meadows rather than the current confluence approximately 1,440 feet west of 164th Avenue SE. The alluvial fans from Indian Meadows and Long Marsh Creeks appear on the 1872 map and the mapped location of May Creek is routed to the southwest around the higher elevations of the Long Marsh/Indian Meadows alluvial fans. The historic channel map for 0291a is consistent with Lidar images showing meander scars in the valley. (Aerial photos and historic map information is located in Appendix A).

May Creek was dredged to form a linear channel between 1910 and 1936 (Foster Wheeler, 1995). A description of May Creek by Bretz (1913) describes May Valley as a "swampy, wide bottomed old channel". A project plan dated 1935 (King County Map Vault) shows creek modifications extending from Lake Washington to 164th Avenue SE.

May Creek, May Valley

Geology



Legend
Qw- Wetland Deposits Organic Rich Sediment
Qvr- Recessional Outwash Deposits Sand and Gravel
Qvt- Vashon Till Compacted Mix of Silt Sand and Gravel
Tpt- Tukwila Formation- Mix of Volcanic and Sedimentary Material

10 5 0 10 20 30 40 Miles

Figure 2

King County

Aerial photos from 1936 show the May Creek channel cut as approximately 25 to 30 feet wide as measured from the aerial photos. The photos clearly show the channel excavation boundaries. The channel is uniform with limited shrubs or trees. Periodic dredging is reported during the 1940s through 1960s (Foster Wheeler, 1995). Property owners may have removed sediment periodically.

Sediment Sources to May Creek

Agriculture and Pastures

In the immediate area of the proposed project there are roughly 8.4 hectares of active animal pasture that abut the stream on both sides with a few animal access points to the stream water (assumed watering holes). Under existing conditions, these animal pasture areas are flooded at stream flows below mean annual flow rate (8.6cfs)—over-bank flooding begins approximately at 6 cfs at the low point in the bank. Thus, its likely sediments that may not have washed off during a rain event with overland flow will be washed off when the stream-system capacity is exceeded and floods overbank. After a flood event, there does not appear to be any visual deposition of sediments resulting from the stream itself and upstream conditions but erosion rills are present in the pastures. Thus, it is assumed that sediments suspended in the water column that flush into the pasture retreat back into the stream system. Given this condition with the added animal activity, sediments from soil disturbance would be additive to upstream sediment loads, thus increasing sediment loads downstream. The proposed project goal is to reduce frequency of pasture flooding, thus sediment loads, from a frequency of any appreciable storm to a near one-year storm frequency.

To assess potential sediment loads from pastures in the project area, similar studies in the Green River watershed were evaluated (King County, 2007). The Green River studies have estimated sediment loads (via total suspended solids) ranging from 50 to 170 kg/ha/yr; residential = 158 kg/ha/yr, commercial = 172 kg/ha/yr, forest = 110 kg/ha/yr, and agriculture = 50 kg/ha/yr. Literature values (Burton and Pitt, 2002) are significantly different with 10, 420, 3, and 343 kg/ha/yr for residential, commercial, forest, and agriculture, respectively. Monitoring stations used for agriculture land use in the Green River watershed study were downstream of pasture lands in ditches that had significant amounts of choking vegetation in them just upstream of the sampling station. Given the relative position of the sampling location and the proximity of vegetation upstream, one may expect the Green River sediment loads to be lower than expected because of the vegetation trapping wash-off loads. Consequently, estimated loads from the May Valley pasture areas are then estimated in the range of 50 – 340 kg/ha/yr (assumed 200 kg/ha/yr average). Simplistically if we estimate loads from the pasture lands to be 200 kg/ha/yr, and post-project loads are reduced in half, then for a ten-year period and 8.4 ha, there is a reduction of 8.4 metric tons of sediment contribution to May Creek. An estimated range would be a reduction of 2.1 to 8.4 metric tons of sediment contributed to May Creek.

Hydraulic model results estimate that the channel capacity to carry bedload and suspended sediment through the project area will be increased after the proposed project by increasing the channel efficiency. Velocities associated with lower flow rates are increased with the removal of vegetation choke points in the channel along with channel-bottom high points that otherwise create backwater conditions conducive to deposition, while depths are increased with a lower channel bottom in conjunction with more water kept in-channel rather than over bank because of improved flow-rate capacity.

Reduced overbank flooding into reed canarygrass may allow the annual volume of fine sediment and muck moving downstream to increase on a yearly basis. Higher flow or flood events would continue to carry stored in-channel and off-channel fine sediment downstream in a larger pulse, rather then metering sediment at lower flows. The cumulative total volume of sediment over a longer time frame, ten years for example, would not be expected to change.

May Creek bottom sediments were sampled by the King County Department of Transportation Materials Laboratory (King County, May 2010 and October 2010, Appendix B). In the area of 146th Avenue SE the channel bottom is composed on sands and gravels, to well-graded gravel. Larger gravel, cobbles and occasional boulders are also present. In the relatively flat and low-gradient portions of May Valley in the area of 148th Avenue SE the hard channel is composed of silty-sand and sandy-silt. At the confluence with Long Marsh Creek the hard-channel bottom is composed of well-graded gravel. A variable layer of semi-liquid, organic rich mud (herein referred to as muck) is present within the stream channel behind constrictions in the channel (Figure 3). The muck was sampled 25 feet upstream of a private bridge at RM 4.6. A modified Loss on Ignition analysis (LOI) was performed on the sample and the organic content was approximately 28 percent. This is a very high percent organic material compared to King County streams (Burkey, personal communication). The exact source of this high organic content is unknown; however, the tributary stream channels within the project area do not contain the same muck material and the most likely sources are pastures, agricultural fields and grass/tree litter within and above the project limits.

Sources of Stream Sediment

Most of the major tributaries to May Valley enter May Creek upstream of 164th or downstream of 146th, outside of the project area. From just below 148th and 164th four tributaries: an unnamed tributary (0291a), Indian Meadows (0291), Long Marsh Creek (0289) and Greenes Creek (0288) enter May Creek. Small alluvial fans occurring at the base of Trib. 0291a and Indian Meadows identify where sediment is deposited at the valley floor.

- A ditch carries Indian Meadows Creek to May Creek. The ditch carrying Indian Meadows has piles of sediment adjacent to the ditch. These appear to be hand dug sediment piles removed from Indian Meadows Creek (Bauman, personal communication). Finer sand and silt reached May Creek and the confluence with May Creek is clogged with silt and reed canarygrass (GeoEngineers, 2008).

- Tributary 0291a is shown on the 1872 map and before development of the valley flowing northwest parallel to May Creek, joining May Creek near the confluence with Indian Meadows. The stream now joins May Creek downstream of 164th and is hydraulically controlled by a culvert under SR-900. Sediment is primarily deposited upstream from the culvert (Foster Wheeler). The creek lacks a defined channel above the confluence with May Creek.
- Greenes Creek enters May Creek west of 148th Street and currently does not contribute significant sediment to the project area because Greenes Creek discharges to a wetland and the confluence with May Creek is choked with reed canarygrass.

Table 1: Two year flow for May Creek Tributaries in the Project Area (Foster Wheeler, 1995).

Drainage	Unnamed Trib. 0291a	Indian Meadows	Long Marsh	Greenes
2 year flow in cfs	23.8*	17	42	26

*USGS StreamStats Estimate

Within the project area, Long Marsh is one of the largest flow (Table 1) and sediment inputs. The Long Marsh sediment deposits constrict flow and muck movement in May Creek. Long Marsh Creek joins May Creek south of May Valley Road near 150th Place NE.

Aerial photography from 1936 shows the creek in a relatively straight channel. The current channel is on the order of two (2) feet wide and several inches in depth at winter low flow. The stream banks are approximately one foot in height, and the surrounding floodplain/fan surface is primarily planted in pasture grass with some recent native plantings. Evidence was found of gravel deposition throughout this reach. Discussions with earlier property tenants indicate that sediment deposition extended into the adjacent pastures following a January 2009 storm event. Long Marsh Creek deposits form an alluvial fan composed of cobble- to silt-sized particles and discharge silt, sand and gravel into May Creek. May Creek channel bottom elevations are higher near the confluence and this channel fill is a choke point for flow within the channel. During high-flow events, Long Marsh carries large gravel-sized sediment to May Creek. Before Long Marsh was straightened, the stream would have migrated across the alluvial fan as sediment was deposited in the stream channel. As noted in the previous section, the Long Marsh and Indian Meadows alluvial fans built out into May Valley and forced May Creek around the fan.

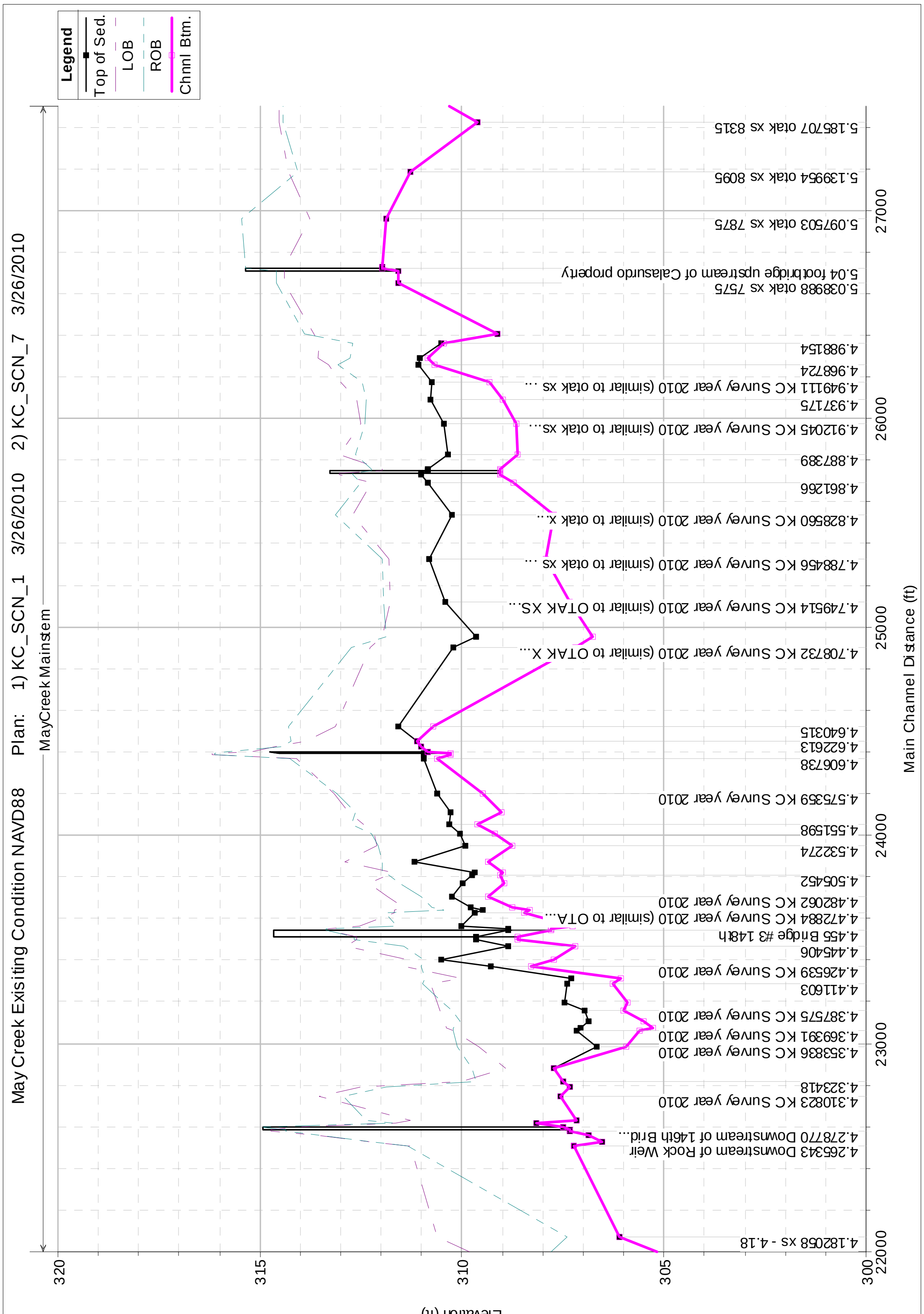
May Creek Channel Changes with Time

Horizontal Boundaries

Aerial photos from 1936 show the May Creek channel cut as approximately 25 to 30 feet wide as measured from the aerial photos. The photos clearly show the channel excavation boundaries. The channel is uniform with limited vegetation. Foster Wheeler measured the mean May Valley Creek channel width in 1995 as 20 to 25 feet, with wider sections up to 60 feet at RM 5.6 (Foster Wheeler, 1995). In March of 2002 a stream survey was conducted between 164th Avenue SE and 148th Avenue SE (O'Rollins, 2002) and measured the average channel width at ten to 14 feet. A stream survey was conducted in 2010 (Thompson and Bauman), and the average wetted width of habitat units was approximately 12.1 feet and the widest wetted width was 23 feet (surveyed reach RM 4.35 to RM 4.87). While no change in average width occurred from 2002 to 2010, there is a possible pattern of channel narrowing between the 1936 and 1995 and comparison between the 2002 and 2010 stream surveys. This is reflected in the available measurements; especially in areas dominated by reed canarygrass. The channel is still a relatively straight excavated ditch but grass, shrubs and trees have encroached into the channel.

Survey data from 2002 and 2010 surveys are also available. Cross sections of May Creek are shown in Figure 4 (cross section locations are shown in Figure 5). Five cross sections were chosen to compare the stream channel at relatively fixed locations in the stream. Upstream of the road bridge at 148th Avenue SE the channel is narrower and slightly shallower (Section B-B). Downstream of the bridge the channel is wider and more uniform in shape (Section A-A). The cross section at Long Marsh (Section D-D) shows the 2002 bank deposits (right bank) associated with excavating sediment from May Creek (private property owner activity) and the filled-in 2002 channel profile from Long Marsh Creek deposits. During the 2002 pilot excavation project in May Creek at the Long Marsh confluence, sediment was removed to approximately elevation 309. The left bank (looking upstream) has now filled in to 2002 elevations at the confluence but the rectangular channel shape is still present on the right bank. Upstream of Long Marsh Creek, the channel is approximately the same width but shallower. This may be due to where the survey staff was placed and the CAD program interpolating between points. Downstream of Long Marsh Creek the channel has narrowed. Survey locations varied slightly between center line, right bank or left bank and cross section elevations are approximate.

Figure 3 May Creek Profile Showing Channel Bottom Elevation and MuckSediment Thickness in 2010 (From King County, 2010a).

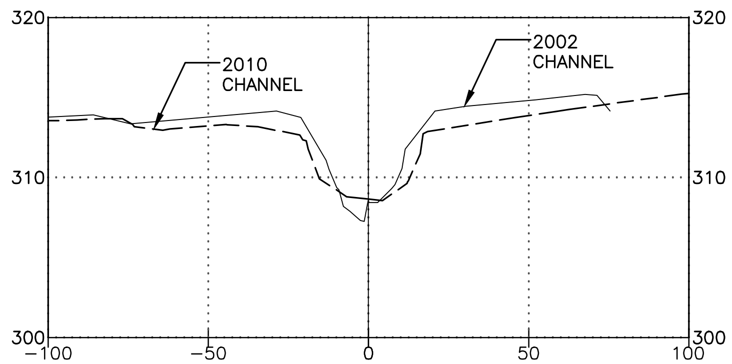


Channel Bottom Elevation

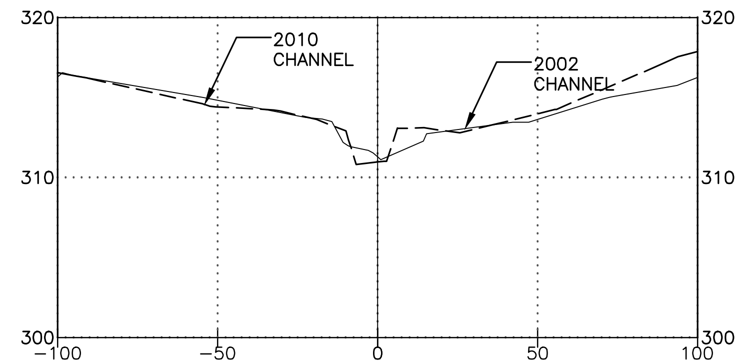
Channel elevation surveys were conducted in 1965, 1979, 1993, 2002 and 2010 (Data is located in Appendix C). A profile of May Creek channel from just below 148th Avenue SE to approximately 1,300 feet upstream of the confluence with Long Marsh Creek as shown in Figure 5. The figure compares the 2002 and 2010 survey profiles and gives spot elevations at the 148th Avenue road bridge and at the horse-crossing bridge on parcel 0223059091, 15019 SE May Valley Road from 1965, 1979, and 1993. Upstream of Long Marsh, between 2002 and 2010 the hard channel bottom is a foot lower in some areas and a foot to two feet higher in others. At the horse bridge the elevation has varied from 307 feet to 311 feet associated with sediment deposition from Long Marsh Creek. From station 11+00 to 8+00 at 148th Avenue, the channel profile has flattened and the channel bottom has shallowed approximately three feet. This area coincides with thick areas of reed canarygrass. Between 1965 and 2010, the 148th Avenue road bridge channel profile has stayed relatively consistent at 307 to 308 feet. It appears from the elevation differences that where the muck and vegetation builds up, the channel bottom has also been aggrading. Changes in the bottom elevation should be considered approximate, perhaps within a foot of elevation change. Survey elevations have not been taken at the exact same locations and stationing is different between projects. Stream profiles in 2002 and 2010 (Figures 4 and 5) show thicker areas of muck build up behind higher elevations in the channel. Up to four feet of muck was measured above the Long Marsh Creek confluence in 2002 and three feet in 2010. Stream and elevation survey data indicates that soft muck present in the channel varies in thickness by location and with time. The muck thickness is variable and transitory, building up in the channel until higher flows in May Creek are able to move the sediment downstream.

Muck and fine sediment is moved downstream by May Creek within the valley as bedload and suspended sediment. However, the valley and May Creek above May Valley is not the main source of sediment to Lake Washington. The May Creek Current and Future Conditions report (1995) identified the major source of sediment to the May Creek delta in Lake Washington as the May Creek canyon and eroding channels of tributaries that enter the mainstem downstream of May Valley.

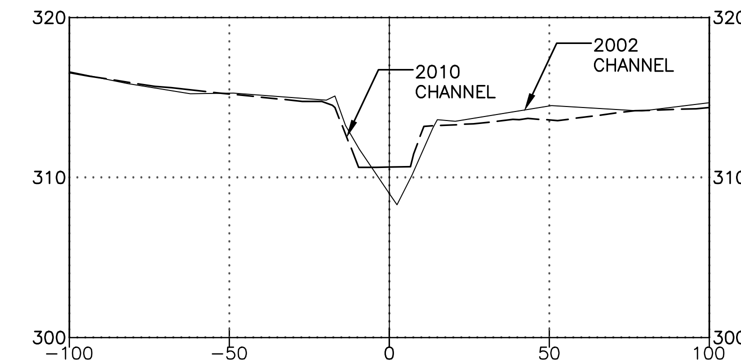
MAY CREEK CHANNEL RESTORATION
FIG. 4 CROSS SECTIONS



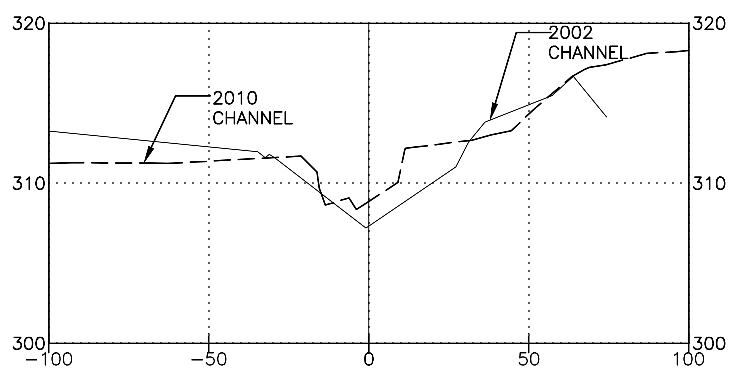
SECTION A–A
STA. 7+00
DOWNSTREAM OF 148TH ST
1
NTS



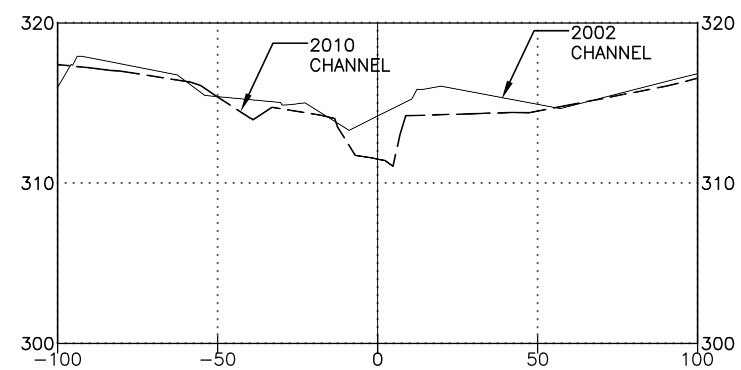
SECTION C–C
STA. 15+00
DOWNSTREAM OF LONG MARSH CREEK
3
NTS



SECTION E–E
STA. 17+00
UPSTREAM OF LONG MARSH CREEK
5
NTS



SECTION B–B
STA. 8+00
UPSTREAM OF 148TH ST
2
NTS



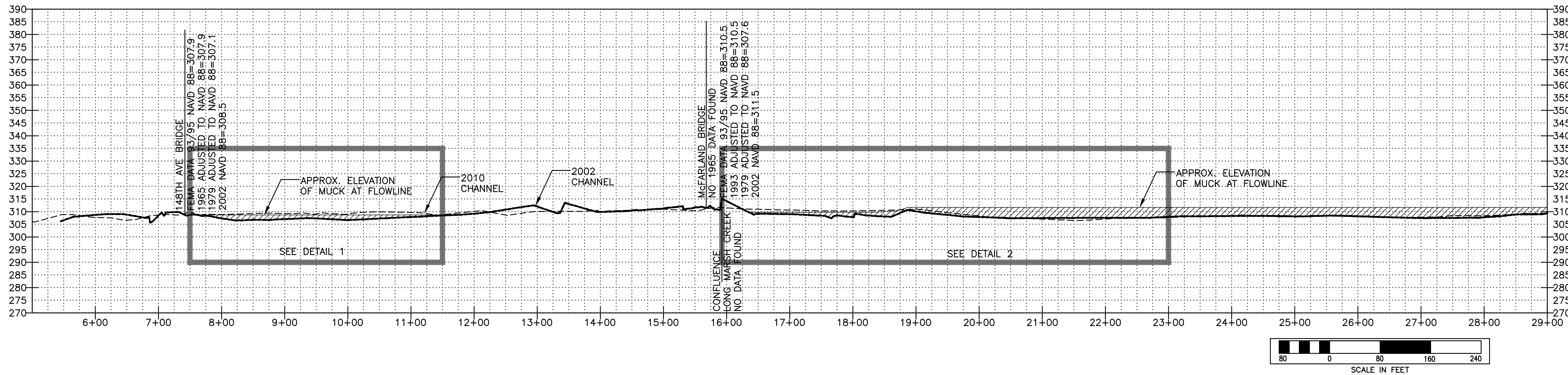
SECTION D–D
STA. 16+00
LONG MARSH CREEK
4
NTS

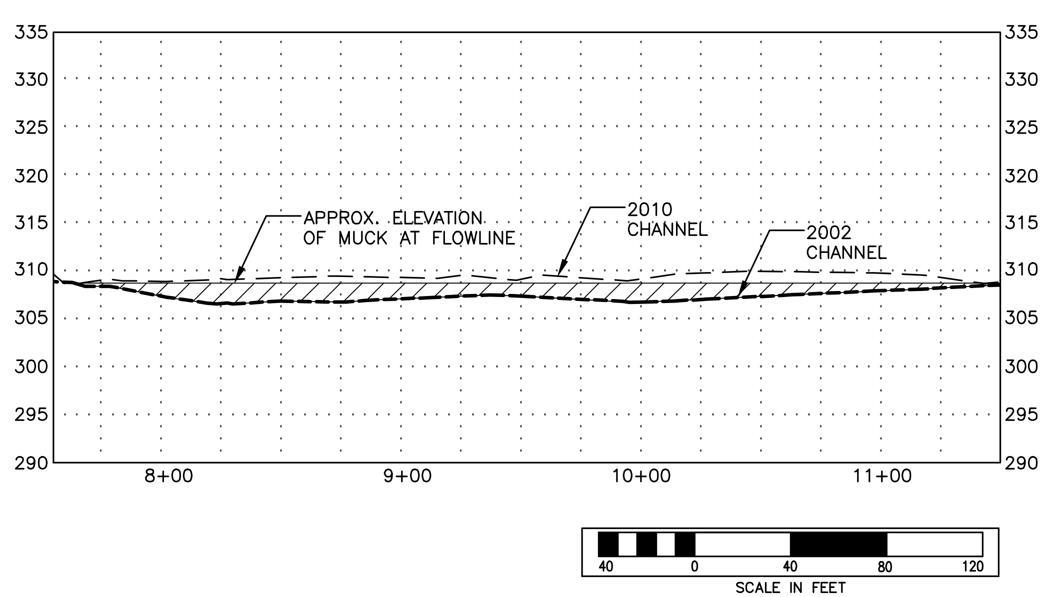
NOTE:

ALL CROSS SECTIONS ARE CREATED LEFT TO RIGHT LOOKING UPSTREAM.

MAY CREEK CHANNEL RESTORATION

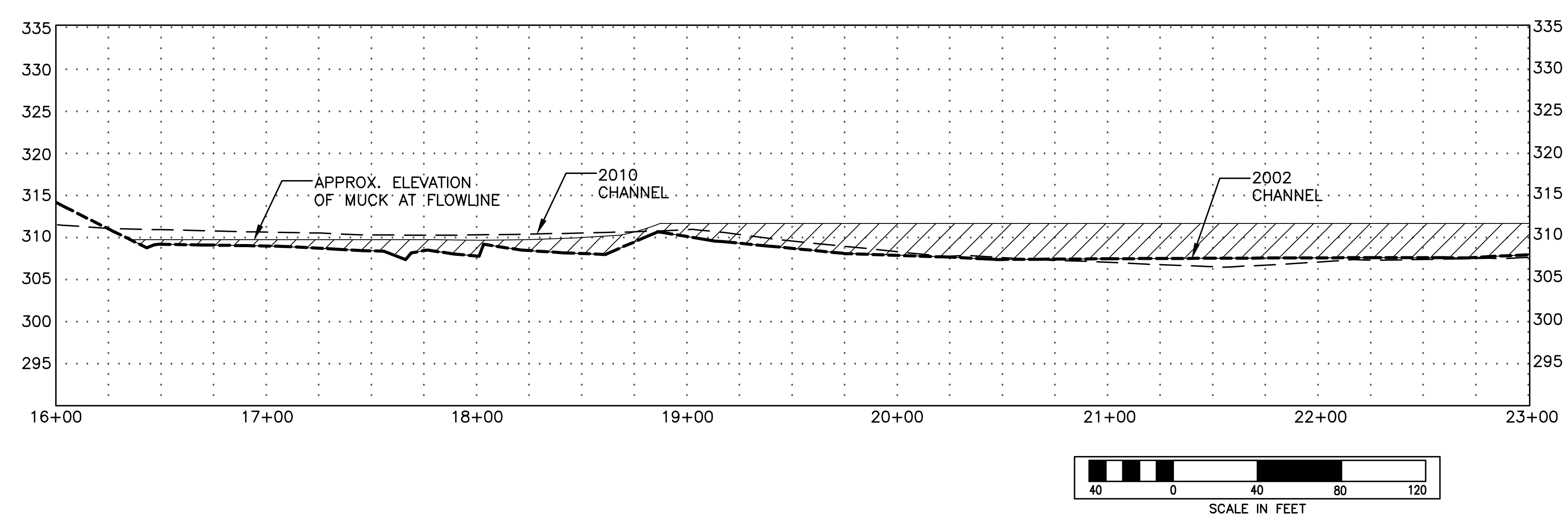
FIG. 5 PROFILES





DETAIL 1

SCALE: 1"=40'



DETAIL 2

SCALE: 1"=40'

Findings: Project Features and Estimated Results

Pre-project May Creek Sediment Sources and Channel Behavior above the May Creek Ravine:

Based on field reviews of the project area, stream report (King County, 2010), a literature review of past reports on the May Creek basin, and a review of aerial photographs a qualitative estimate of sediment sources has been developed. Sediment entering the project area comes from:

- Upstream May Creek (east of 164th). Most of the major tributaries enter May Creek above the project and therefore will be a contributor to suspended sediment in the Creek. Six beaver dams are present or have been active in the past above the project area; two below 164th and four upstream of the project.
- Long Marsh Creek is a contributor to channel fill by sand, gravel and small cobbles. The larger materials are able to reach May Creek during high flows due to the straight channel, slope and past channel maintenance by property owners.
- Indian Meadows Creek is a minor drainage that is partially ditched through a pasture that reaches May Creek and contributes sediment to May Creek.
- Tributaries (0291A, 0291) contribute minor but unknown amounts of fine sediment.
- Stormwater runoff and pasture flooding contributes an estimated .2 to .8 metric tons of organic material and sediment to the stream.

The May Creek channel is essentially a ditch, excavated in a historic wetland system prior to 1930. The gradient in May Valley is very low and the creek is only able to transport clay to sand sized sediment.

- The May Creek channel stores organic muck/sediment from pastures behind relatively high spots in the channel bottom and releases it downstream to the ravine during higher flows. Muck then builds up again as flows recede and during rain events. Some of the muck contributes to aggrading the channel bottom as it is trapped and entrained by vegetation.

The May Creek project proposes a number of features to reduce sedimentation to May Creek and channel filling. The 70% design plans include:

- removal and control of reed canarygrass (Phalaris arundinacea);
- native plant buffers along the banks;
- reducing overbank flooding;
- selected removal of vegetation from the channel downstream of 148th Avenue SE;
- excavated alcoves adjacent to the channel downstream of 148th Avenue SE,
- a sediment management design for Long Marsh Creek, the primary source of sediment and channel constriction in the project area.

These features are expected to produce the following results:

- Removal and control of reed canarygrass will slow channel narrowing and infilling due to growth during spring and summer during low flows.

- Adding plant buffers on either side of May Creek will shade the banks where reed canarygrass is present and help control grass growth and encroachment.
- Reducing over-bank flooding of pastures will reduce the amount of sediment and organic material being carried to the creek by an estimated .2 to 0.8 metric tons per year.
- Improved channel hydraulic efficiency will improve and move fine sediment and organic material that reaches the creek downstream, reducing the amount of sediment trapped in reed canarygrass above 148th Avenue SE.
- The proposed alcove excavation and planting areas west of 148th Avenue SE will allow the creek to overflow into the alcoves during higher flows; this will slow the current velocities and minor amounts of sediment will drop out of suspension, but the amount of deposition is unknown.
- The May Creek channel is likely to be both a depositional area and a source of suspended sediment during higher flows. Soft muck in the stream bottom above the confluence with Long Marsh Creek is a combination of organic material from pasture runoff with mineral sediment. The muck builds up in the channel after rain storms and floods and is moved downstream during higher flows. Reducing flooding within the project area will help reduce the build up of muck in the channel.
- A mitigation project in Long Marsh Creek will intercept gravel and large sand-size sediment reaching May Creek.
- Bank stabilization with jute netting and seeding will reduce erosion and sediment input to May Creek after excavation.

Estimated Changes in Sediment Transport and Channel Dimensions after Drainage Improvement Project:

The proposed project elements and existing conditions were evaluated for how sediment would enter and move within the project area. If no change in behavior was expected, the conditions were assumed to remain the same and are listed below as "constant". If the project element was expected to modify sediment behavior by qualitatively reducing the amount of sediment reaching May Creek, a reduction is noted in the bulleted list below. During construction, temporary increases in sediment are possible and this is noted.

- *Constant* Upstream May Creek (east of 164th). Most of the major tributaries enter May Creek above the project and therefore will continue to be a contributor to fine sediment in the Creek. Beaver dams will hold back sediment and periodically release it when breached.
- *Constant* Tributaries (0291A, 0291 and Indian Meadows Creek) contribute unknown amounts of fine sediment. These are expected to be minor.
- *Reduction* Small proposed mitigation alcoves downstream from 148th will allow sediment to deposit at higher flows.
- *Reduction* Long Marsh Creek mitigation project will minimize course sediment reaching May Creek and channel infilling.
- *Reduction* Reduced pasture flooding will reduce the organic material and sediment discharged to the stream, estimated at .2 to .8 metric tons.

- *Reduction* Reduce channel narrowing by controlling reed canarygrass along the banks by establishing a buffer of plants on either side of the channel and shading the banks.
- *Temporary Increase* Channel excavation will temporarily expose "raw" bank and channel sediments to the channel. Jute matting and bank planting will control erosion but minor erosion within the channel may occur as the channel stabilizes.
- *Change in fine sediment movement* Fine mineral and organic sediments that reach May Creek and are now stored in the stream channel or trapped by grass during low flows will move downstream during lower flows. Fine sediment and organic material currently stored in the channel and moved downstream during high-flow events, will move downstream at a constant rate rather than episodic rate.

The overall estimate is a net reduction in fine sediment and organic material reaching May Creek within the project area. Long Marsh Creek mitigation, the mitigation alcoves, reduced flooding, and reed canarygrass control are project features that decrease sediment contributions to May Creek in the project area. Controlling willow and reed canarygrass will control channel narrowing.

Responses to Questions on Project Performance

Question 1: Will the project change sediment delivery downstream to May Creek?

Response: The May Creek Current and Future Conditions report (Foster Wheeler, 1995) identified the major sources of sediment to May Creek as coming from the ravine and tributaries below May Valley. The hydraulic analysis (King County, 2010a) shows that changes in flow velocity below 143rd Avenue SE are negligible. Sediment movement is controlled by flow. Therefore, the same size sediments would be moved within the May Creek system. Muck sediments are currently stored behind topographic highs in the stream channel and are moved downstream in pulses during high flow events. In general fine sediment that does enter the creek as bedload or suspended sediment will move downstream due to improved channel efficiency rather than being stored in the creek channel above 148th, incorporated into the banks and moving though during large flow events. However, some fine sediment or muck that does enter the creek will continue to be stored behind topographic highs in the channel or in topographic lows above and below 148th Avenue. We estimate the project-related reductions in sediment delivered to the creek primarily from reduced overbank flooding, will reduce the total fine sediment and organic muck in the stream.

Question 2: After the proposed drainage improvement project and mitigation on May Creek in May Valley, will sediment refill the May Valley project area?

Response: We estimate that there will be an overall reduction in sediment contributions to May Creek within the project area. The stream channel bottom elevation is relatively stable, except where Long Marsh Creek discharges to May Creek and where reed cannarygrass and muck aggrades the channel. Reducing sediment and organic matter input to the channel from Long Marsh Creek and the pastures and removing reed canarygrass will slow narrowing of the channel. Active monitoring and buffer-planting management along the creek banks will take place for ten years to allow establishment of native vegetation buffers. The larger channel can be expected to last beyond ten years.

This assessment is based on qualitative analysis with available information. Quantitative sediment estimates are not available.

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