

Drainage Management Guide for Whatcom County Drainage Improvement Districts



ACKNOWLEDGEMENTS

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Drainage Management Guide for
Whatcom County Drainage Improvement Districts

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PREFACE

With an annual market value well over 326 million dollars, Whatcom is the sixth leading agricultural producing county in Washington State. It has been able to achieve this prominence by building drainage systems that removed the major limiting factor to growing crops; i.e. wetness, flooding and high water tables. As beneficial as draining, dredging and tiling practices are for farming, their unrestrained utilization have been harmful to the environment.

Whatcom once also produced large populations of salmon and trout. Now, Spring Chinook Salmon, Bull Trout and Steelhead Trout are listed as “threatened” with extinction under the Federal Endangered Species Act. Soon Coastal Cutthroat Trout will likely join their ranks. Most farming occurs along the lowland tributaries that is critical habitat to these species. All of these tributaries are also on the Washington Department of Ecology’s 303(d) list for one or more water quality problems under the Federal Clean Water Act.

These ill effects are by no means caused by Agriculture alone. Urbanization, poor forest practices and harvest management have also contributed significantly to the degradation. Regardless, farmers can contribute to a better environment by abandoning harmful practices, adopting better management practices and agreeing to enhancement projects. This guide shows how in the context of drainage system management.

In producing this guide we have learned and benefited from the good work of many who have sought to reconcile the inherent conflict between maintaining drainage and maintaining fish habitat. The planning process and best management practices described here were refined in collaboration with farmers, tribes and regulatory agencies. We sought to respect and address each of their needs as important stakeholders to come up with a program that will “foster a healthy, sustainable relationship between people and the environment”. Such is the mission of the Whatcom Conservation District.

George J. Boggs, Esq.
District Manager

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WHY IS THE GUIDE NEEDED?

This Guide provides information about how to develop and implement a Drainage Management Plan (DMP) in Whatcom County. A DMP is similar to a Farm Conservation Plan and, when combined with appropriate permit applications, will result in a “shovel ready” five-year work plan.

This Guide is also intended to defuse the potential conflict between Drainage Improvement Districts (DIDs) and other agencies to ensure that both long term farming interests and natural resources are protected.



The objectives of this Guide are to:

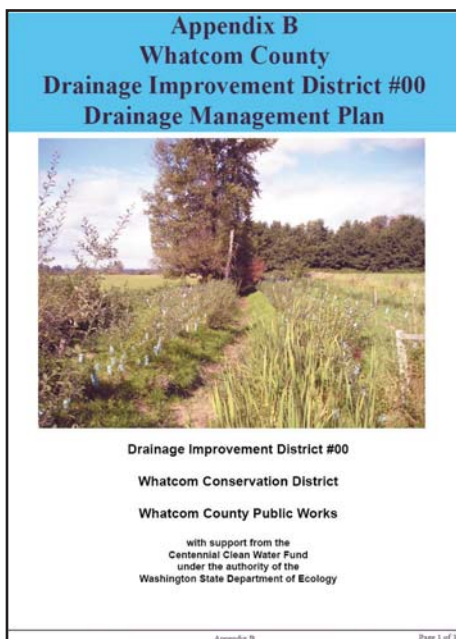
1. Provide clear direction and guidance to DIDs so that they can efficiently prepare multi-year Drainage Maintenance Plans that ensure proper functioning of their drainage systems.
2. Ensure that DID maintenance work addresses public natural resource concerns and complies with: Endangered Species Act (ESA), Hydraulic Code, Clean Water Act (CWA) and Growth Management Act (GMA).
3. Make drainage maintenance more sustainable and cost effective by encouraging better land use practices to keep sediments and noxious vegetation out of watercourses reducing maintenance needs.

Benefits to Drainage Improvement Districts:

- Better knowledge of drainage system infrastructure based on reach by reach assessments.
- Easier permitting using agreed upon BMPs from the Guide. Five year permits for routine maintenance activities can be obtained.
- Certainty of permit requirements based upon watercourse classification.
- Cost savings from using new or different drainage management techniques.
- Easier budgeting once maintenance needs are assessed.
- Potential for funding once Habitat Improvement Projects are prioritized.

Benefits to Local, State and Federal regulating agencies:

- General - Regulatory certainty of resource protection BMPs and regulatory efficiencies from consolidated permit applications using predictable processes. Also the opportunity to prioritize Habitat Improvement Projects designed in part to offset the impacts of drainage maintenance work.
- Whatcom County - Regulatory efficiencies when one application (SEPA, critical areas, shorelines) will encompass five years of activities rather than individual applications for each activity.
- Washington Department of Fish and Wildlife - Regulatory efficiencies when one application (JARPA) will encompass five years of activities rather than individual applications for each activity.
- Federal Agencies (Corps, NOAA, USFWS) - Regulatory efficiencies when one application (JARPA) will encompass five years of activities rather than individual applications for each activity. Also the opportunity to systematically determine jurisdiction based upon watercourse and BMPs.



THE GUIDE FORMAT

This guide is divided into 5 SECTIONS for easy reference.

SECTION 1 Drainage Maintenance in Whatcom County provides important background information on the responsibilities of a DID commissioner, laws and regulations affecting drainage maintenance, and information about how drainage and drainage maintenance affects natural resources.

SECTION 2 Drainage Management Plans provides step by step guidance describing how to create a Drainage Maintenance Plan.

- Step 1 - Prepare a General Overview of the DID
- Step 2 - Map and Classify Watercourses
- Step 3 - Inventory and Map other Infrastructure
- Step 4 - Map Significant Natural Resources
- Step 5 - Identify DID Maintained Watercourses and Divide into Reaches
- Step 6 - Schedule Drainage Maintenance Work by Reach
- Step 7 - Adopt Best Management Practices
- Step 8 - Identify Habitat Improvement Projects and Set Goals
- Step 9 - Adopt Monitoring, Reporting and Adaptive Management Plans

SECTION 3 Factsheets provides easy reference for DID commissioners, regulatory agency staff, drainage contractors and other stakeholders involved in drainage maintenance or impacted by its effects.

- *Permitting Factsheets #1-5* provide detailed information on laws, regulations, and permitting processes necessary for drainage maintenance work.
- *BMP Factsheets #6-17* provide information on the Best Management Practices that must be followed when implementing drainage maintenance work.
- *Informational Factsheets #18-22* provide additional information on subjects related to drainage maintenance.

SECTION 4 contains **Definitions and Acronyms**.

SECTION 5 Appendices:

- A. Habitat Improvement Opportunity information from Whatcom County Shorelines Master Program and Critical Areas Ordinance
- B. Sample Drainage Maintenance Plan

1 DRAINAGE MAINTENANCE IN WHATCOM COUNTY

DID Commissioner Job Description

The role of an elected drainage improvement district (DID) commissioner has changed dramatically in recent years. The days of draining land with minimal regulatory oversight are in the past. Now land within the jurisdiction of a DID is not only farmed, but also supports residential, commercial, and industrial land uses. The needs of a wide spectrum of landowners, combined with increased regulations from other jurisdictions and agencies, make the role of commissioner a more complex and time-consuming job than many ever imagined.



Job Description

The role of commissioner is simple - do everything. Large and active districts in other counties hire staff to share the workload. Whatcom County and Whatcom Conservation District staff may be available to provide technical assistance in some situations, but ultimately the commissioners are responsible for making sure required processes are completed. Among typical duties are:

- Attend annual meetings.
- Schedule and attend other meetings as needed.
- Complete a Drainage Management Plan (DMP) and use it to guide maintenance work.
- Complete and sign permit applications (may be part of DMP).
- Hire contractors and purchase materials needed to implement projects.
- Be available and responsible to all landowners within the district.
- Develop annual budgets and set annual landowner assessments.
- Monitor district infrastructure and work with landowners to prevent drainage problems.

Ethics, Responsibility and Liability

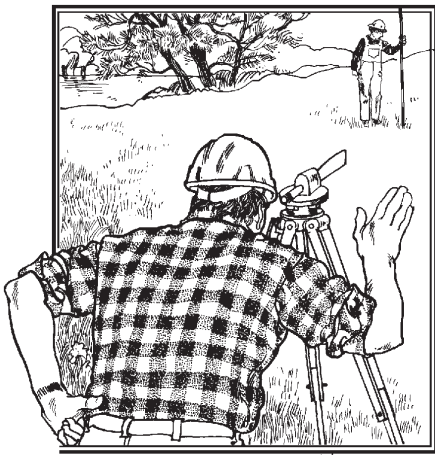
An elected DID commissioner is a public official subject to the same scrutiny as any other County office holder such as a County Council member or the County Executive. DID commissioners represent the residents of their respective districts and must ensure that all activities undertaken by their districts follow applicable laws and regulations. Failure to do so may not only expose their district (and its taxpayers) to fines but may also expose them to legal action.

Concerns may include:

- Personally benefiting from district activities.
- Purchasing or contracting without using approved procedures.
- Authorizing work without obtaining required permits.
- Violating permit requirements, including failure to implement BMPs and/or mitigation agreements.

Compensation

Traditionally the position of DID commissioner is unpaid. State law does however allow commissioners compensation at \$90.00 per day up to \$8,640.00 per year. Districts can also hire staff to monitor drainage infrastructure, manage projects, and work with landowners to prevent future problems.



Diking and Drainage, Title 85. RCW

With their enabling statute adopted in 1895, DIDs were among the first types of special districts in Washington. DIDs can sue, assess landowners, and condemn property through eminent domain. In 1911, additional powers were granted to DIDs including constructing, straightening, widening, deepening, and improving all rivers, watercourses or streams causing overflow damage to land.

The original laws governing DIDs are still valid, however the drainage activities they authorize may now violate other laws written to protect natural resources. Environmental concerns associated with drainage management activities include negative impacts to water quality, fish, and fish habitat.

Endangered Species Act 16 USC § 1532

The Endangered Species Act (ESA) is a federal law written to protect any species at risk of extinction. DIDs may be at risk of committing a “take” of threatened or endangered species by harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting any listed species. This broad prohibition has been interpreted to bar even ordinary land use activities such as farming or forestry or site development, if the result of such activities would be significant habitat modifications or degradation where it actually kills or injures wildlife by interfering with essential biological functions such as feeding, breeding, or sheltering. Recent listings of spring Chinook, bull trout, and steelhead and the potential listing of coastal cutthroat trout have resulted in protections of water quality, quantity and fish habitat throughout Whatcom County. The National Oceanographic and Atmospheric Administration Fisheries Service (NOAA Fisheries) and the United States Fish and Wildlife Service (USFWS) implement the Federal ESA. Collectively referred to as the “Services”, they can impose a fine up to \$25,000 for a “take” of listed species.

Clean Water Act 33 USC § 1251, Section 401, 402 and Washington State Water Pollution Control Act 90.48 RCW

Under the federal Clean Water Act (CWA), it is unlawful to discharge any pollutant from a point source into navigable waters unless a permit is first obtained. The U.S. Environmental Protection Agency (EPA) has set water quality standards for contaminants in surface waters. EPA has also established wastewater standards for industry. The standards describe how much pollution can be allowed after All Known And Reasonable Technologies (AKART) have been applied. Point sources are discrete conveyances such as pipes and man-made ditches.

The Washington Department of Ecology (WDOE) implements the CWA in Washington State through authority delegated by the EPA. The EPA has also delegated authority to the Lummi Nation Natural Resources Department to implement certain sections of the CWA for lands under the Lummi Nation’s jurisdiction. WDOE is also charged with implementing the State’s Water Pollution Control Act (WPCA) and the Lummi Natural Resources Department is charged with implementing the Lummi Nation Water Resources Protection Code. The effect of these two laws (CWA and WPCA) is the extension of water quality standards to all surface and ground waters. Federal and state water quality standards have been established to sustain public health and public enjoyment of the waters and for the propagation and protection of fish, shellfish, and wildlife.

Stormwater Management Manual for Western Washington

Volume II Construction Stormwater Pollution Prevention

Prepared by:
Washington State Department of Ecology
Water Quality Program

February 2005
Publication No. 05-10-30
(A revision of Publication No. 99-12)

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Rivers and Harbors Act of 1899 33 USC §403 and Clean Water Act 33 USC §404

The Department of the Army Corps of Engineers (ACOE) is responsible for enforcing the provisions of the Rivers and Harbors Act and jointly administers Section 404 of the Clean Water Act with the EPA. Under Section 403 of the Rivers & Harbors Act of 1899, a Section 10 Department of Army permit is required for work or structures in or affecting navigable waters of the U.S. Under Section 404 of the Clean Water Act, an ACOE permit is normally required for the discharge of dredged or fill material (e.g., fill, excavation, or mechanized land clearing) into the “waters of the U.S.” Waters of the U.S. include navigable and interstate waters, their tributaries, and certain adjacent and abutting wetlands.

An ACOE permit may not be required for maintenance work on some watercourses if certain BMPs are used to avoid fallback. See 33 CFR 323.4(a)(3); and 33 CFR 323.2(d)(1), (2)(ii) and 33 CFR 232.2(d)(4)(i). When an ACOE permit is required, a DID will need to fund a Biological Assessment and consultation with the National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS).

Failure to obtain a permit under the CWA can result in civil penalties up to \$25,000 per day and fines of \$10,000 per incident. Best practice is to submit a permit application to the ACOE for determination of jurisdiction.

Hydraulic Code 77.55 RCW

All construction projects in State waters are governed by RCW 77.55. Any person or government agency planning work in a watercourse must obtain a Hydraulic Project Approval (HPA) permit from the Washington Department of Fish and Wildlife (WDFW). A “hydraulic project” is any work that will use, divert, obstruct, or change the natural flow or bed of any of the salt or freshwaters of the State. Drainage maintenance activities will generally require a HPA. Failure to obtain a HPA before engaging in maintenance activities can result in enforcement actions and civil penalties.

Shorelines Management Act 90.58 RCW and Growth Management Act 36.70A RCW

The Shorelines Management Act requires each county and city to prepare a shoreline “master program” in accordance with the shoreline guidelines issued by the Washington Department of Ecology in 1972.

The Whatcom County Shoreline Management Program was first adopted in 1976 then updated in 2008. Under its provisions, agricultural activities within shorelines are to be governed by the critical area ordinance (CAO). This includes designated stream channels and all associated wetlands, floodways and upland areas within 200 feet of the Ordinary High Water Mark (OHWM).

The Growth Management Act (GMA) requires Whatcom County to adopt county-wide planning policies that protect “critical areas” and existing “shoreline values”. Watercourses and wetlands are critical areas within DIDs. Adjacent to wetlands, the standard buffer width can range from 25 feet to 300 feet depending upon the type of activity and type of wetland. Buffer widths adjacent to streams range from 50 feet wide for non-fish bearing streams, to 100 feet wide for fish bearing streams and 150 feet wide for shoreline streams. Failure to comply with the County’s CAO can result in a stop work order and a civil offense punishable by a \$1,000 fine for each day of work.

2009
WASHINGTON STATE
Joint Aquatic Resources Permit
Application (JARPA) Form

USE BLACK OR BLUE INK TO ENTER ANSWERS IN WHITE SPACES BELOW.

Part 1-Project Identification
Unique project information that makes it easy to identify.

1a. Unique Project Identifier Number (UPI #) [text]
• Don't have one yet? Get one at <http://www.dnr.wa.gov> or call the Washington Governor's Office of Regulatory Assistance at (800) 337-2003.

1b. Project Name (Examples: Smith's Dock or Seabrook Lane Development) [text]

Part 2-Applicant
The person or organization legally responsible for the project. [text]

2a. Name (Last, First, Middle) and Organization (if applicable) [text]

2b. Mailing Address (street or PO box) [text]

2c. City, State, Zip [text]

2d. Phone (1) [text] **2e.** Phone (2) [text] **2f.** Fax [text] **2g.** E-mail [text]

Part 3-Authorized Agent or Contact
Person authorized to represent the applicant about the project. (Note: Authorized agent(s) must sign 11b. of this application.) [text]

3a. Name (Last, First, Middle) and Organization (if applicable) [text]

3b. Mailing Address (street or PO box) [text]

3c. City, State, Zip [text]

3d. Phone (1) [text] **3e.** Phone (2) [text] **3f.** Fax [text] **3g.** E-mail [text]

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WHATCOM COUNTY CRITICAL AREAS ORDINANCE

WHATCOM COUNTY
CRITICAL AREAS ORDINANCE
TITLE 16
CHAPTER 16.16

Whatcom County Planning and
Development Services

Adopted by Whatcom County Council
September 2005
(Revised February 2007)

Drainage Related Environmental Impacts

Long Term Impacts from Agricultural Drainage

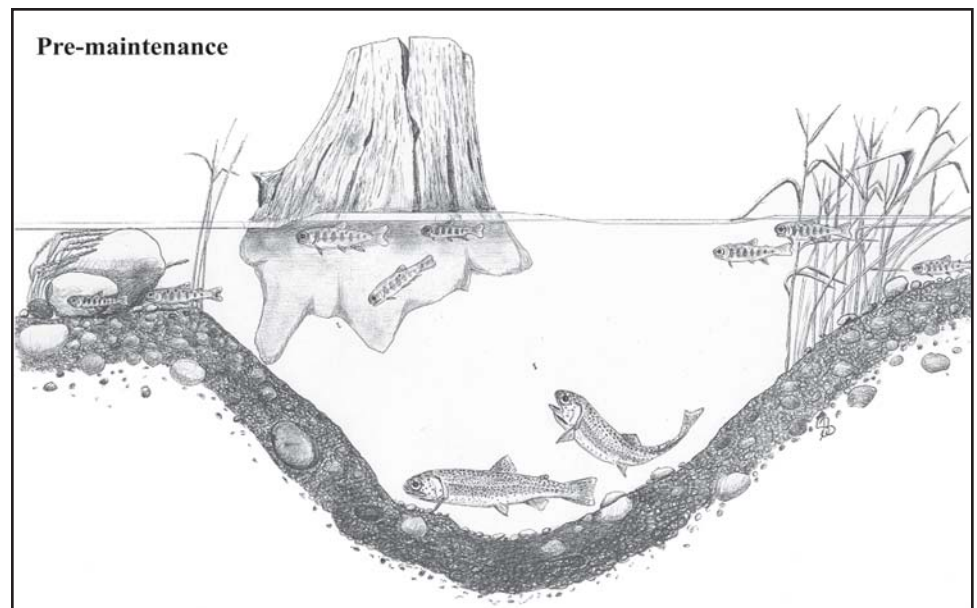
Good drainage improves the productivity of agricultural soils. Consequently, most watercourses in lowland Whatcom County have been modified to better drain adjacent lands. New watercourses (ditches) were constructed to further drain land and make agriculture possible. Modifications such as channel straightening and removal of streamside vegetation have had large and often negative impacts related to water quality, water quantity, fish, and fish habitat.

Increased Winter Storm Flows - Prior to modification for drainage and agriculture, winter rains were intercepted by vegetation and absorbed into the ground. Drainage infrastructure facilitates rapid surface flows that can result in damage to fish and habitat and to increased flooding downstream.

Reduced Summer Flows - Historically, winter stormwater was stored in wetlands and in the soil, becoming available at a later time to supplement low summer flows. Drainage infrastructure removes water from the system during winter and spring months, resulting in decreased summer flows and associated negative impacts to water quality and fish.

Vegetation Removal - Trees and shrubs that once lined watercourses were removed in order to allow access for modifying the watercourse. Water quality protections and fish habitat provided by the native vegetation were also lost.

Disconnection from Floodplain and Meander Zone - As watercourses were deepened and straightened to improve drainage, they lost connection to the surrounding floodplain and lost the natural meanders essential to fish habitat.



Short Term Impacts from Drainage Maintenance

Drainage maintenance activities have negative impacts to natural resources including water quality, fish and fish habitat. Vegetation removal using mowers or herbicides, dredging and other maintenance work can muddy the water, kill fish, and remove fish habitat. Specific impacts include:

Removing Fish Habitat -Riparian cover, aquatic vegetation, submerged woody debris, and channel features such as pools and riffles are all essential habitat features for fish. Grass, shrubs and trees along channel banks provide shade that helps mediate temperature, supply nutrients for aquatic life and offers fish protection from predators. Mowing or applying herbicides to vegetation on the

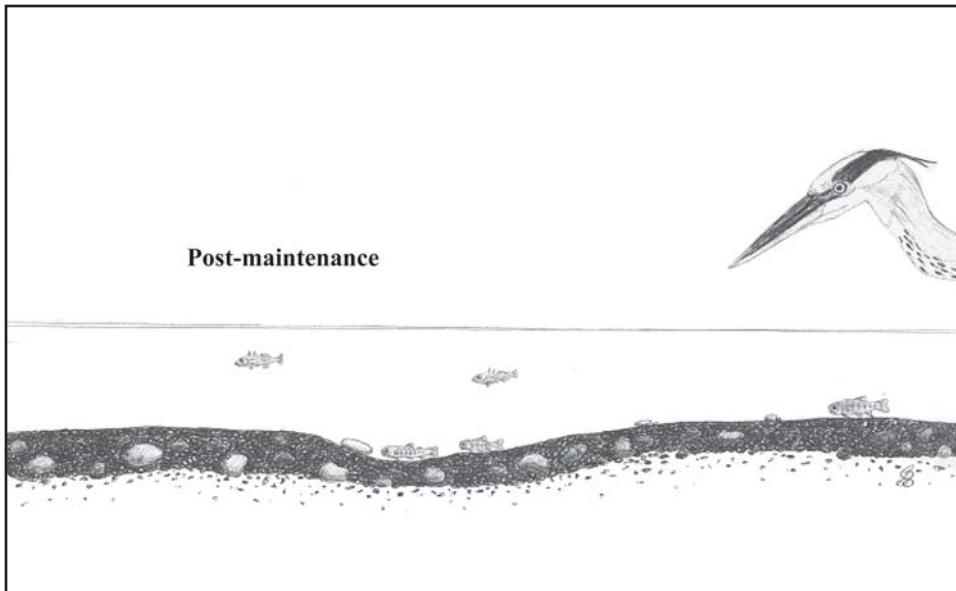
channel banks and dredging the channel will improve drainage, but also removes important habitat features. The remaining fish may no longer have shade, food, or protection from predators.

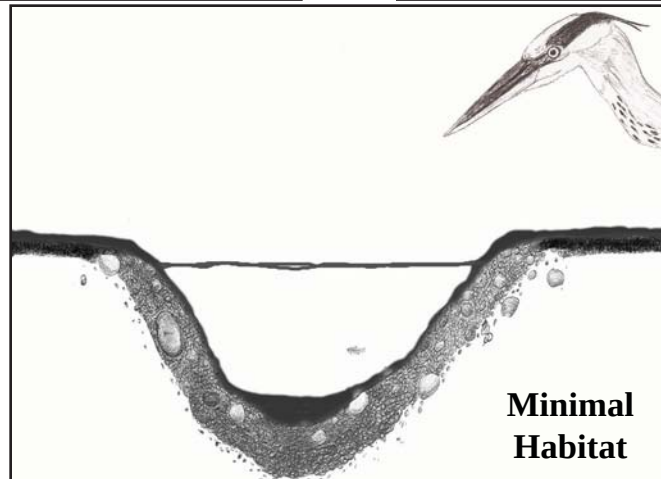
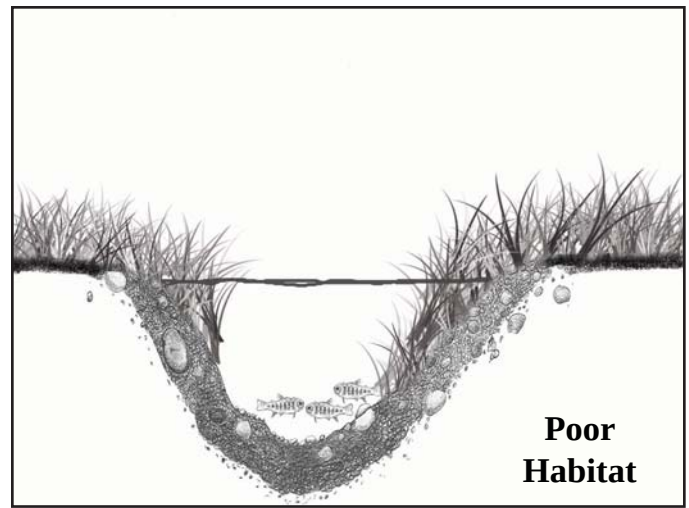
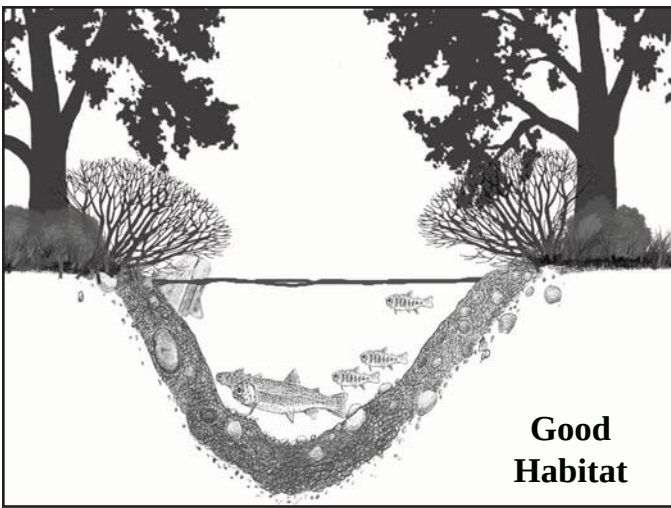
Altering the Channel - Straightening, widening, or smoothing out the bottom of a channel reduces the quantity, quality, and diversity of available habitat. Widening the channel can change water depth and allow higher flows to pass downstream. Higher flows can wash fish out of the system, disrupt pool formations, and increase bank erosion. Channel features such as riffles provide habitat for aquatic insects, which are an important source of food for fish. Although some aquatic insects and fish species will remain following channel alteration, the populations will not be as diverse or healthy as before and natural recovery can take decades.



Fish Kills - Dredging, more so than other drainage maintenance activity, can kill fish directly. Fish can be removed from the channel in an excavator bucket and buried in spoils, crushed in the water by dredging equipment, or suffocated due to sediment release, low dissolved oxygen levels, or reduced flow during dredging.

Removing Vegetation - Bank vegetation helps keep the water cool in summer by blocking sunlight. Higher water temperatures are stressful to most fish species, particularly salmon and trout, which require cold water. Bank side vegetation can also help improve water quality by filtering potential pollutants, including sediment, and by providing food for fish. Removing this vegetation can reduce or eliminate an important source of food for fish and result in high water temperatures that are harmful to fish.





Reduced Water Quality - Drainage maintenance work, including dredging, also has significant impacts to water quality. Suspended sediment changes fish behavior, inhibits their ability to find food, clogs their gills, affects their ability to resist parasites and disease, or may directly kill fish. Sediment released during maintenance activities can disrupt downstream habitat by clogging gravels and filling in pools, side channels, and riffle areas that are necessary for spawning and the development of juvenile fish.

Drainage maintenance activities can also reduce water quality by releasing pollutants trapped in bottom sediments or by dramatically reducing the amount of dissolved oxygen available to fish and other aquatic organisms. Once the maintenance work is complete, water temperatures may increase due to exposure of the water surface to sunlight.



2 DRAINAGE MANAGEMENT PLANS

Introduction to Drainage Management Planning

Once completed, the DMP can be submitted with appropriate permits and result in both a five-year work plan and five-year permits.

A properly developed and adhered to Drainage Management Plan (DMP) will provide a Drainage Improvement District (DID) with the foundation needed to maintain its drainage infrastructure while protecting natural resources and following all applicable laws. The following steps contain the elements needed to support both good drainage practices and natural resource protection.

Step 1 - Prepare a General Overview of the Drainage Improvement District

Step 2 - Map and Classify the Watercourses

Step 3 - Inventory and Map other Infrastructure

Step 4 - Map Significant Natural Features

Step 5 - Identify DID Maintained Watercourses and Divide into Reaches

Step 6 - Schedule Drainage Maintenance Work by Reach

Step 7 - Adopt Best Management Practices

Step 8 - Identify Habitat Improvement Opportunities and Set Goals

Step 9 - Adopt Monitoring, Reporting and Adaptive Management Plans

Drainage Management Plan Steps

Step 1: Prepare a General Overview of the Drainage Improvement District

Long serving commissioners likely know their district well. This probably is not the case for new commissioners and regulatory agency staff. Creating an overview is the first step in describing the DID and will give future commissioners and agency staff a better understanding of the drainage system, how it works, and the importance of planned maintenance activities.

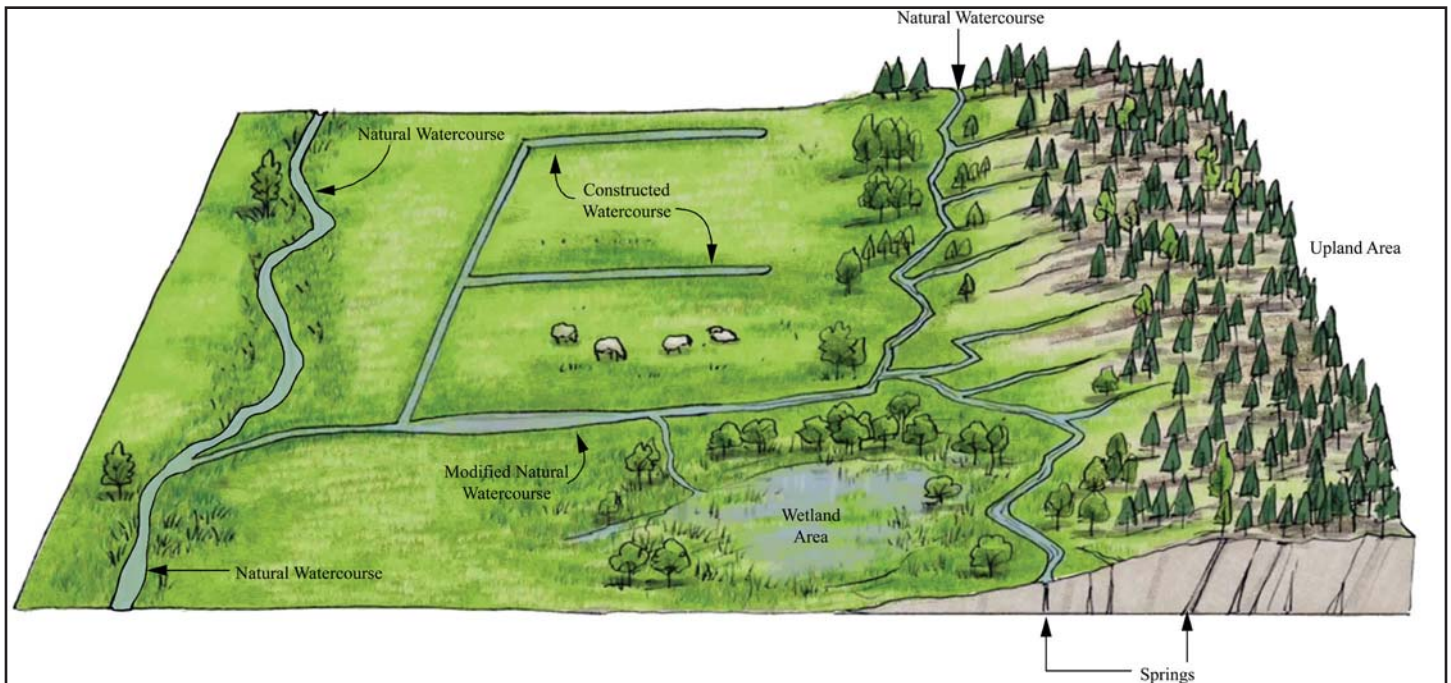
A Drainage Management Plan overview will include:

- A description of the DID location and its proximity to other jurisdictions
- A general description of its boundaries
- Number of acres in the DID
- A description of significant land and water features (wetlands, recreation areas, uplands, floodplains, fish populations, etc.)
- A description of predominant land uses
- A list of predominant drainage maintenance issues (beaver dams, sediment accumulation, aquatic weeds, etc.)



Step 2: Map and Classify the Watercourses

Watercourses within a DID must be accurately classified as part of a Drainage Maintenance Plan. Accurate classifications will ensure that a DID and regulating agencies know what Best Management Practices (BMPs) are needed prior to any drainage maintenance work. Watercourses are classified as Natural, Modified Natural, and Constructed.



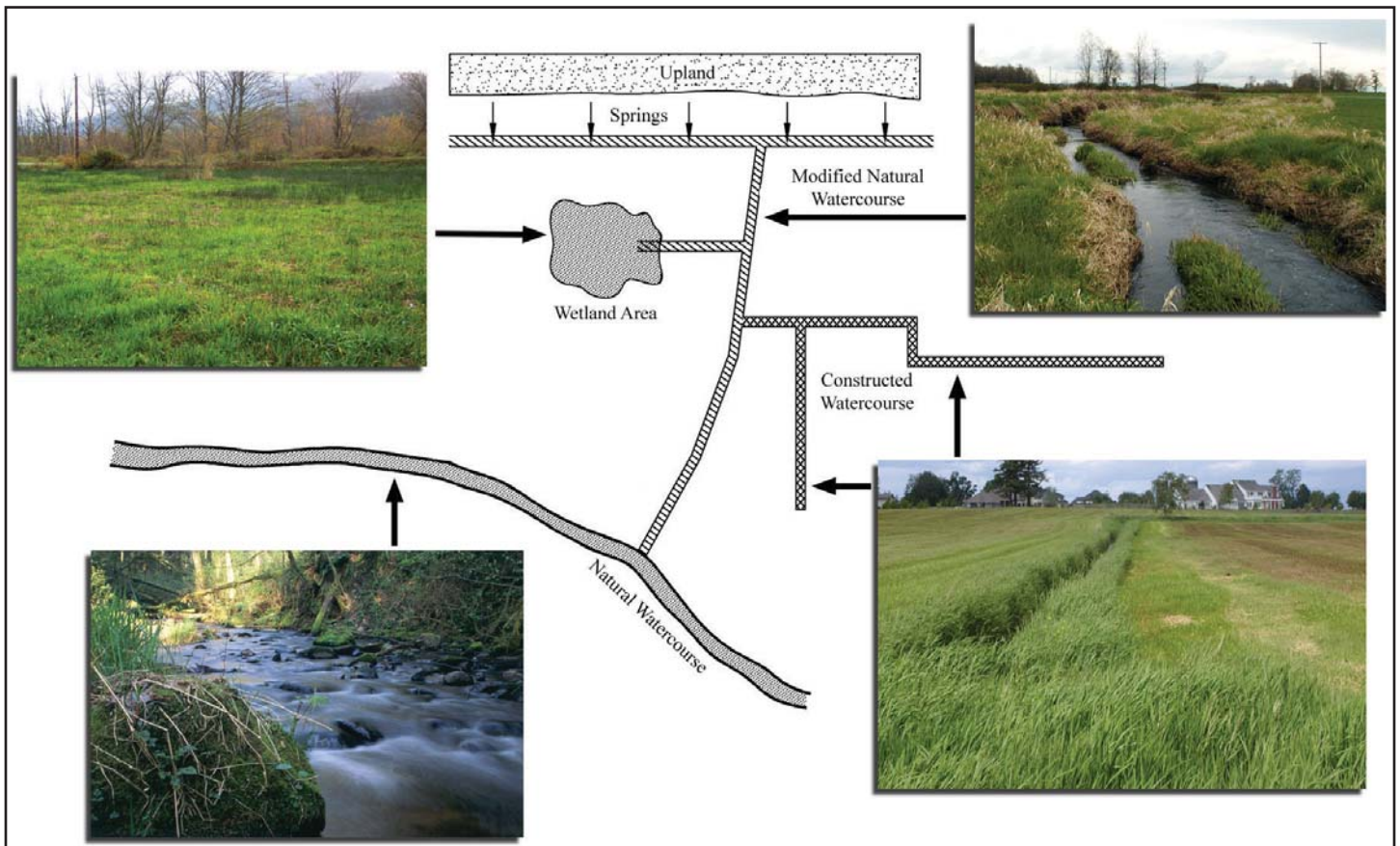
Accurately classifying watercourses for your DMP may take a little time but is worth the effort. To begin, work with your Conservation District planner to map the watercourses using the best available Geographic Information System (GIS) data. Commissioners should then review the classifications and submit them to the Washington Department of Fish and Wildlife (WDFW) for concurrence. Generally, natural and modified natural watercourses will parallel the Northwest Indian Fisheries Commission (NWIFC) fish presence maps.

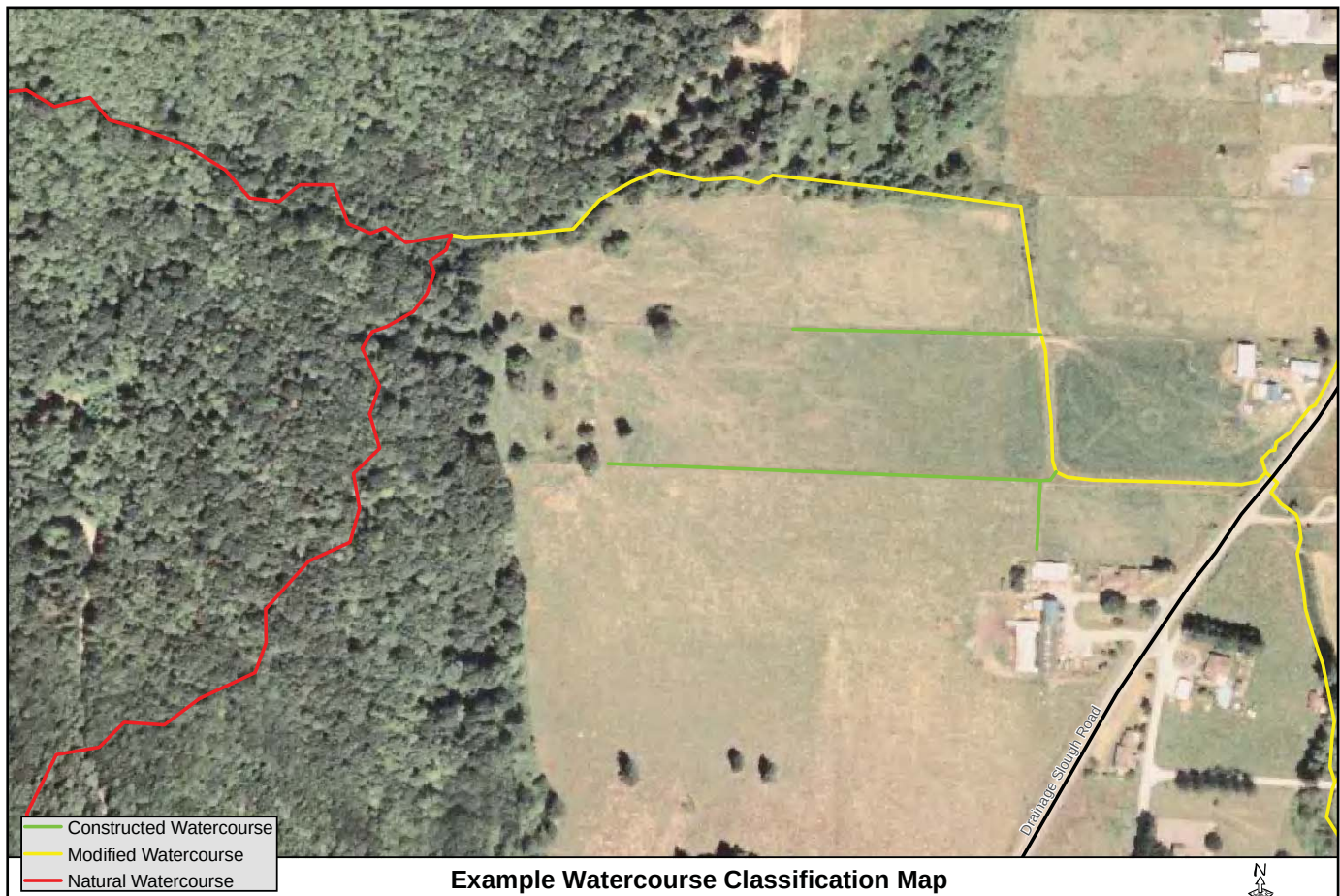
Natural Watercourses (Red): Natural watercourses have not been significantly altered from their historical flow path or floodplain in any manner and have headwaters (usually from wetlands or springs). **Natural watercourses do not typically exist within DID boundaries of Whatcom County and maintenance work on natural watercourses is not addressed by a DMP.** Any work in or near natural watercourses will require individual permits.

Modified Watercourses (Yellow): Modified watercourses are historically natural systems that have been diverted, dredged, straightened, and/or diked.

- Appropriate permits including a HPA from WDFW are required for any drainage maintenance work. A completed and approved DMP packaged with permit applications will enable WDFW to issue five-year HPAs allowing drainage maintenance work on these watercourses.
- A DMP must be approved by Whatcom County Planning and Development Services (WCPDS) before any maintenance activities can occur within 150 feet of any “shoreline” watercourse and within 100 feet for all others.
- Permit applications for work modified watercourses must also be sent to the ACOE. Maintenance exemptions may be received for some watercourses or ACOE permits may be required.
- Best Management Practices (BMPs) listed in the DMP must be implemented to minimize impacts to fish and water quality and to avoid violation of State Water Quality Standards (or Tribal Water Quality Standards for lands under the jurisdiction of the Lummi Nation Natural Resources Department).

Constructed Watercourses (Green): Constructed watercourses, also known as ditches, convey drainage water from an individual farm, or supply water to an individual farm property. Constructed watercourses do not have headwaters or other natural water sources. They may hold water permanently or intermittently. The presence of water necessitates use of Best Management Practices. Drainage Maintenance work on constructed watercourses can be done without permits, as long as the work does not impact natural or modified watercourses downstream. If water is present, BMPs listed in your DMP must be implemented in order to avoid violation of State Water Quality Standards or Tribal Water Quality Standards for lands under the jurisdiction of the Lummi Nation Natural Resources Department.

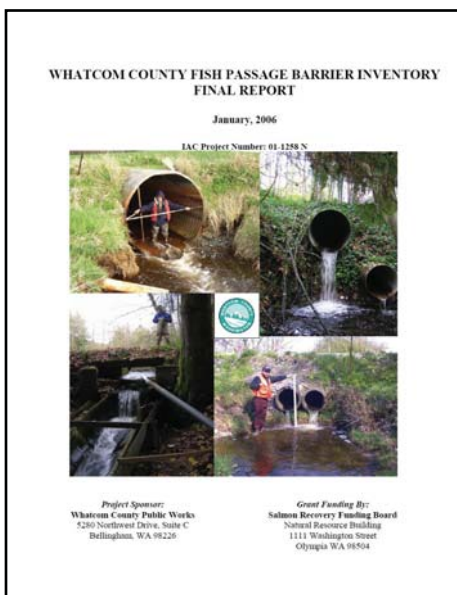




Example Watercourse Classification Map

Step 3: Inventory and Map Other Infrastructure

Watercourses are the primary type of drainage infrastructure in Whatcom County. However, other structures likely exist that also impact either drainage or habitat, including: culverts, floodgates, tidegates, sediment traps, etc. It is important to know what the structures are and where they exist, regardless of whether or not they are maintained by the DID. The DMP should include a list of all infrastructure as well as a map locating each structure. The sample DMP found in Appendix B demonstrates how to map and record infrastructure on an inventory list.



Crossings - Bridges and culverts have the potential to impede drainage and to act as fish passage barriers. Whatcom County's Fish Passage Barrier Inventory is a great resource and can be viewed at <http://whatcomsalmon.wsu.edu> or obtained from WCPDS. If a barrier has been inventoried, that inventory number should be used to identify the structure. In the absence of an inventory number, the structure should be labeled as unknown, with a DID inventory number added (i.e. UNK17-01).

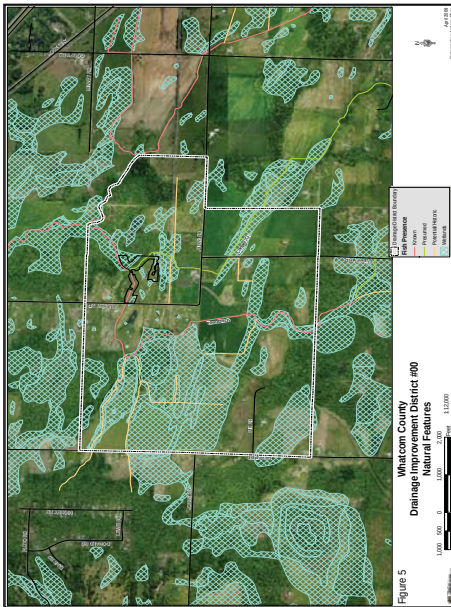
Sediment Traps - Sediment traps are rare in Whatcom County but must be documented when they exist. They should be located on the DMP map and described in the DMP with accompanying photos.

Floodgates and Tidegates - Also rare in Whatcom County DIDs, floodgates and tidegates should be located on the DMP map and described in the DMP with accompanying photos. Note: Maintenance of floodgates and tidegates will not be permitted or addressed in this DMP.

Other infrastructure - Inventory and map any other unique drainage infrastructure within district boundaries.

Step 4: Map Significant Natural Features

Natural features (wetlands, fish presence, etc) that exist within a DID will have an impact on how maintenance work is completed and may also provide opportunities to plan Habitat Improvement Projects that will offset the negative impacts associated with drainage maintenance.



Fish Distribution: Fish presence or the potential for fish to be present is probably the most important natural feature that must be addressed in a DMP. Start by working with your Conservation District planner to map the fish presence layer developed by the Northwest Indian Fisheries Commission. This mapping tool will tell you where fish may be present or where populations were once sustained and therefore have the potential to one day re-populate. Watercourses mapped with fish presence should be classified as modified natural (or natural). Fish protection BMPs must be implemented prior to drainage maintenance work on watercourses with fish presence.

Constructed watercourses are assumed to have so little habitat value that fish will not be present. During the DMP review process it is possible that WDFW will note particular constructed watercourses that are known to have fish presence. In these rare cases the watercourses should be treated as modified natural watercourses.

Wetlands: Wetlands are “land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, water tolerant vegetation, and various kinds of biological activity which are adapted to a wet environment” (National Wetlands Working Group, 1988). Drainage maintenance work can impact wetlands in two primary ways:

- Wetlands adjacent to maintained channels may be impacted (drained) by maintenance work. Site specific BMPs may be needed to ensure that wetland hydrology is not affected.
- Wetlands can be impacted by being filled with dredge spoils.

Work with your Conservation District planner to map all wetlands in the DID and reference their location in the reach analysis (Step 5).

Step 5: Identify DID Maintained Watercourses and Divide into Reaches

Many miles of watercourses may exist within a DID; however, not all of these watercourses are maintained by the DID. Typically, information about which watercourses are “District” maintained channels is handed down commissioner to commissioner and landowner to landowner. The DID should hold legal easements allowing access to maintain these channels.



1. Research and document DID maintained watercourses by working with Whatcom County River & Flood division staff to determine which channels have been maintained in the past and whether legal easements exist for properties along the watercourses. Clearly map these channels on the DID map to ensure that regulatory agency staff know exactly where the DID is responsible for maintaining drainage and where landowners are responsible for their own channel maintenance.

Characteristics of maintained watercourses within a DID typically will vary reach to reach, requiring different maintenance practices. For the purposes of completing a DMP, a “reach” is defined as a homogenous length of watercourse with similar physical, chemical and biological conditions. Assessing drainage maintenance needs by reach will facilitate both drainage management planning and permitting. Including in a DMP some detailed knowledge of each watercourse reach will help for both management purposes and for permitting.

Reach: A Reach is a homogenous length of watercourse that has a uniform set of physical, chemical, and biological conditions

2. Divide District maintained watercourses into reaches; then map and label the reaches. Describe all relevant conditions including:

- Reach Description - Describe where the reach begins and ends.
- Reach Length - Record length in feet.
- Reach Habitat Conditions - Describe channel substrate, presence of large woody debris, etc.
- Reach Riparian Characteristics - Describe dominant watercourse bank vegetation, presence of native trees or shrubs
- Fish Passage Barriers within the Reach - Describe known or suspected barriers.
- Spawning Habitat - Note areas with suitable gravels and gradient for spawning.
- Typical Cross Section - Plot at least two channel cross sections to document current size and capacity.
- Reach Fish Utilization - Describe fish presence in the reach using mapped fish distribution GIS layer and any available local anecdotal information.
- Typical Reach Photos - Include at least two photos that adequately represent existing watercourse conditions.
- Reach Drainage Infrastructure - Describe DID maintained infrastructure such as the watercourse, culverts, bridges, etc.
- Reach Habitat Improvement Opportunities - Describe any site specific opportunities to improve habitat conditions that could be completed to offset the impacts of drainage maintenance work. Opportunities may include: bank re-vegetation, fish passage barrier removal, wetland enhancements, etc.

Step 6: Schedule Drainage Maintenance Work by Reach

Schedule up to five years of drainage maintenance work needed for each reach within the DID. Describe all drainage maintenance work planned during the next five years. Consider both the cost of maintenance work and the negative impacts that drainage maintenance has to the watercourse, water quality, fish, and fish habitat. Implement drainage maintenance projects when they are absolutely needed and use the maintenance practice with the least impact.

Tip: Although you may not be able to precisely predict all needed maintenance, try for accuracy. You can always do less work than what is in your Plan.

- Maintenance Dredging - Describe areas where maintenance dredging is planned. Include information about any planned measures to increase the interval expected before the need to dredge the reach again in the future.
- Watercourse Vegetation Management - Describe areas where mowing above the waterline is planned. Include any planned measures to increase future maintenance intervals.
- Culvert Maintenance - Describe areas where culvert maintenance is planned. Include any planned measures to increase future maintenance intervals.
- Bridge Maintenance - Describe areas where bridge maintenance is planned. Include any planned measures to increase future maintenance intervals.
- Herbicide Spraying - Describe areas where herbicides will be used to control channel vegetation. Include any planned measures to increase future maintenance intervals.
- Beaver Dam Management - Describe areas where beaver dams are likely to occur and will require removal or modification. Include any planned measures to reduce the need to remove beaver dams in the future.
- Sediment Trap Maintenance - Describe areas where sediment trap maintenance is planned. Include any planned measures to increase future maintenance intervals.
- District Specific Maintenance Practices - Describe any areas where maintenance work not listed above is planned. Detail the work planned and explain why this work is needed.

Step 7: Adopt Best Management Practices



Section 1 of this Guide described numerous laws and regulations that apply to drainage maintenance work and also described the negative impacts maintenance work has to water quality, fish and fish habitat. A Drainage Maintenance Plan must include specific and detailed procedures to minimize impacts. *Factsheets* found in Section 3 of this Guide contain descriptions of Best Management Practices (BMPs) that have proven effective in the field and been approved by regulatory agencies. The following *Factsheets* are specific to drainage maintenance activities and include BMPs approved by permitting agencies. Adoption of these *Factsheets* as BMPs will ensure speedy approval of the DMP and facilitate the issuance of appropriate permits.

- *General Drainage Maintenance BMPs - BMP Factsheet #6*
- *Maintenance Dredging BMPs - BMP Factsheet #7*
- *Beaver Dam Management - BMP Factsheet #8*
- *Watercourse Vegetation Management - BMP Factsheet #9*
- *Aquatic Herbicides and Watercourse Maintenance - BMP Factsheet #10*
- *Culvert Maintenance and Replacement - BMP Factsheet #11*
- *Bridge Maintenance and Replacement - BMP Factsheet #12*
- *Sediment Traps - BMP Factsheet #13*
- *Constructed Watercourse Maintenance - BMP Factsheet #14*
- *Fish Protection - BMP Factsheet #15*
- *Water Quality Protection Measures - BMP Factsheet #16*
- *Hand Maintenance - BMP Factsheet #17*

These *Factsheets* describing BMPs should be attached to your DMP with copies distributed to all contractors and landowners that will be maintaining drainage in the DID. Failure of any party to adhere to these BMPs will result in violation of permit conditions and will needlessly negatively impact natural resources.

Step 8: Identify Habitat Improvement Opportunities and Set Goals

Section 1 of this Guide provides detailed information on the negative impacts to water quality, fish and fish habitat from drainage maintenance. Using appropriate BMPs discussed in Step 7 will minimize these impacts, but additional measures must also be planned and implemented in order to offset the impacts of continued drainage maintenance work. Habitat Improvement Projects in the past have been referred to as “mitigation”, but are more productively thought of as another of the DID’s responsibilities necessary for both the continued legal implementation of maintenance work and for the health of natural resources within DID boundaries.

Appendix A of this Guide provides detailed information from Whatcom County’s Critical Areas Ordinance and Shorelines Master Program regarding Habitat Improvement priorities for agricultural lands.



1. Prioritize and List Habitat Improvement Projects

- Work with your Conservation District planner and WDFW habitat biologist to plan projects that adequately offset the negative impacts of drainage maintenance.
- Review Appendix A of this Guide for Habitat Improvement Opportunities prioritized by the Whatcom County Shorelines Master Program and for prioritization criteria from the Critical Areas Ordinance.
- Talk with landowners. Ultimately individual landowners will need to agree to any Habitat Improvement Project suggested for their property.

Habitat Improvement Projects that benefit both Drainage and Natural Resources - The highest priority habitat improvement projects are likely to benefit both the DID and the public. DIDs will benefit from improved long term drainage. The public will benefit from protection and enhancement of other natural resources. These projects are frequently supported by grants from public or private organizations. Examples of this project type include:

- Replacing a culvert that impedes drainage and is also a fish passage barrier.
- Planting a native tree or shrub “hedgerow” that will shade the watercourse and control invasive grasses, while also improving water quality and fish habitat.

Habitat Improvement Projects that primarily benefit Natural Resources

The second tier of projects are those that primarily benefit water quality, fish habitat or other natural resources. This type of project may be a higher priority from an environmental perspective but does not directly benefit a DID. These projects are usually funded primarily by other public or private organizations with support and facilitation by the DID. A DID may contribute to this type of project by recruiting willing landowners, writing letters of support to potential funding sources, or in other ways to ensure projects are implemented. Examples of this project type include:

- Planting large riparian buffers in areas where access to the watercourse for future drainage maintenance work is not needed.
- Placing large woody debris in a watercourse to provide fish habitat.
- Restore associated wetlands to decrease stormwater flows, increase summer flows, recharge groundwater, and to provide areas for sediment storage and nutrient cycling.



Informational *Factsheets* found in Section 3 of this Guide provide basic information for some project types. Expertise and experience are required to implement any Habitat Improvement Project. Work with staff from other agencies, a Conservation District planner, non-profit groups or private consulting firms to ensure that projects are successfully implemented.

- *Culvert Maintenance and Replacement - BMP Factsheet #11*
- *Watercourse Re-vegetation - Informational Factsheet #20*



Land Use Practices - Section 1 of this Guide also provides information about how agricultural land uses impact water quality and fish. A DID can lessen its negative impacts to natural resources by working with landowners to reduce farm-based impacts. For example, persuading crop farmers to install and maintain a grass filter strip will help keep field sediments out of the watercourse. Preventing sedimentation of the watercourse protects water quality and also reduces the need for the DID to remove these sediments in the future. The following informational *Factsheets* found in Section 3 of this Guide provide information on practices that can be implemented to prevent degradation of water quality and habitat due to agricultural land uses.

- *Drainage Water Quality - Informational Factsheet #19*
- *Farm Practices - Informational Factsheet #22*

2. Set a Five Year List of Realistic Habitat Improvement Projects

Work closely with your Conservation District planner and WDFW area habitat biologist to ensure that your list of projects:

1. Adequately offsets the negative impacts of the drainage maintenance work planned in Step 6.
2. Can be implemented with available funding. Keep in mind that although other funding may be available for some Habitat Improvement Projects, ultimately the DID is responsible for funding and implementing their own projects.
3. Have a high probability of success. Choose projects that use well-tested methods in areas with a good likelihood of landowner participation.

Step 9: Adopt Monitoring, Reporting and Adaptive Management Plans

Tip: Strategically placed staff gauges will help you monitor water levels.

Monitoring - The expected result of writing, adopting, and permitting a Drainage Maintenance Plan is the implementation of drainage maintenance work, followed by the implementation of Habitat Improvement Projects. Monitoring is the means to document results:

- Drainage Improvement - Did the maintenance work improve drainage as planned?
- Best Management Practices - Were BMPs implemented as written in the plan? Were the BMPs effective?
- Habitat Improvement Projects - Are they functioning as planned?

Monitoring data is reported to permitting agencies during the DID's annual meeting and is a crucial part of ensuring that permit requirements are met.

Drainage Improvement Monitoring - Measure and record water levels during the growing season before and after drainage maintenance work. This could be as thorough as complete surveys of the watercourse or as simple as a few measurements at fixed points such as bridges or sub-surface drain outlets. The information should be recorded and retained with DID records to document improvement and provide a baseline by which to compare future conditions.

Best Management Practices - BMPs attached to the DMP represent the best known technologies to minimize negative impacts from drainage maintenance work. DID commissioners or contractors implementing maintenance projects should keep a field log noting what BMPs were used and how effective they were. This information will be invaluable when adapting BMPs for the next project.

Habitat Improvement Projects - A log of project implementation should be kept to document when projects were completed and to record project success over time. If these projects are implemented by a third party, request monitoring documentation from the organization responsible and keep with DID records. Photographic monitoring may be the best way to record accomplishments.

Reporting - Results determined from monitoring should be recorded and discussed at the DID annual meeting. Copies of all monitoring reports will be made available to WDFW at this meeting. In addition, a list of all drainage maintenance work completed in the year prior to the meeting will also be reported. Results that should be reported at the annual meeting include:

1. Drainage Maintenance work completed.
2. Drainage Improvements measured from maintenance work.
3. Best Management Practices implemented, noting their effectiveness.
4. Habitat Improvement Projects implemented, noting their effectiveness

Adaptive Management - This Guide and your Drainage Maintenance Plan were created using the best available information. However, circumstances change and a DID should be ready to adapt. The monitoring noted above and other sources of information should be discussed at the DID's annual meeting and changes made to the DMP if needed. Examples may include:

- Changes to scheduled drainage maintenance - Unforeseen events may require adjustments to the planned schedule.
- New or adapted BMPs - New cost-effective strategies may be suggested.
- Changes to Habitat Improvement Project list - Projects may need to be added or removed from the list as feasibility is assessed or if landowner willingness changes.

CONGRATULATIONS
Once these steps are completed you have created a Drainage Management Plan for your District.

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3 FACTSHEETS

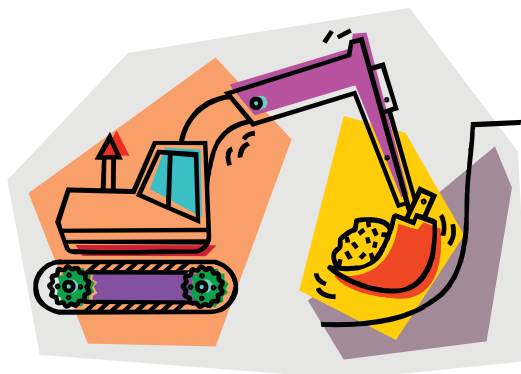
Permitting Factsheets

1. Hydraulic Project Approval
2. Water Pollution Control Acts
3. Growth & Shorelines Management Acts
4. Agency Contact Requirements
5. Emergency Drainage Maintenance



Best Management Practices Factsheets

6. General Drainage Maintenance BMPs
7. Maintenance Dredging BMPs
8. Beaver Dam Management
9. Watercourse Vegetation Management
10. Aquatic Herbicides and Watercourse Maintenance
11. Culvert Maintenance and Replacement
12. Bridge Maintenance and Replacement
13. Sediment Traps
14. Constructed Watercourse Maintenance
15. Fish Protection
16. Water Quality Protection Measures
17. Hand Maintenance



Informational Factsheets

18. Watercourse Classifications
19. Drainage Water Quality
20. Watercourse Re-vegetation
21. Bank Stabilization Techniques
22. Farm Practices



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Permitting Factsheets



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Drainage Management



Permitting Factsheet #1

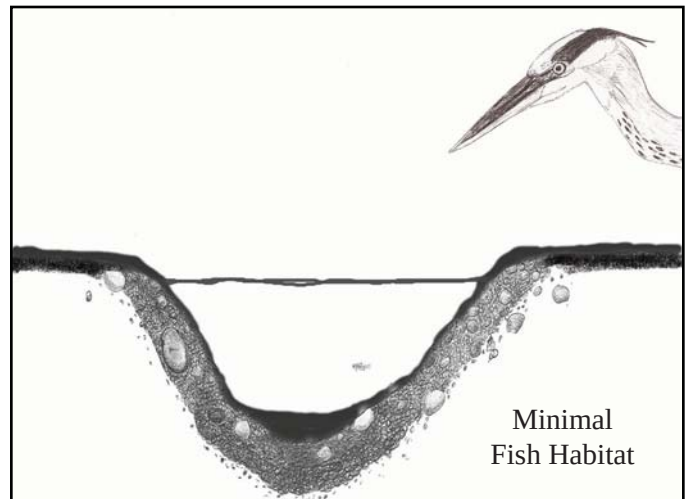
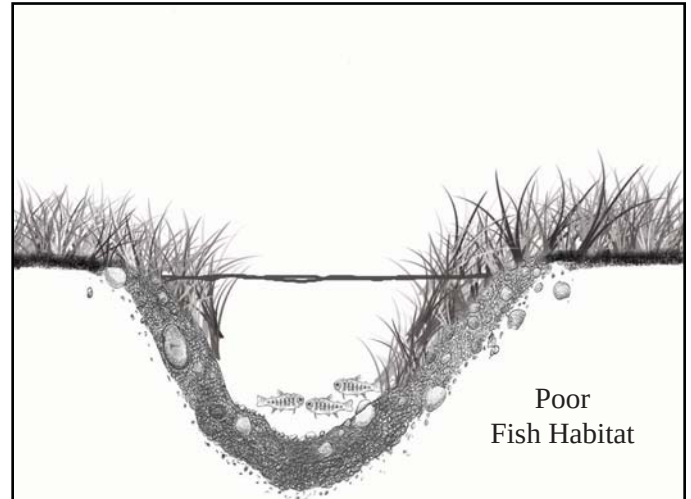
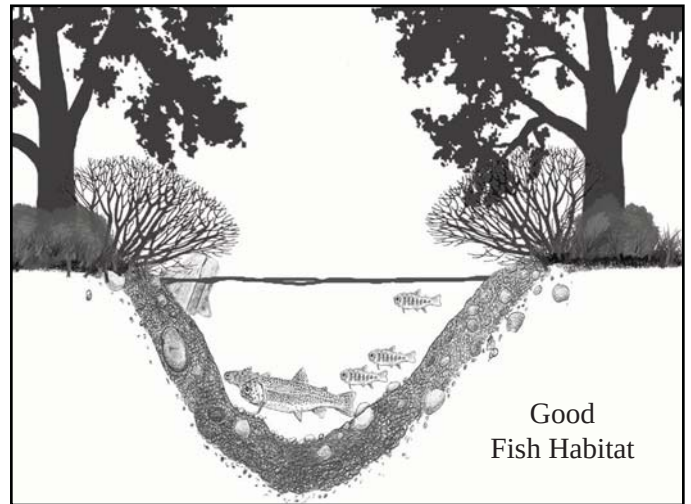
HYDRAULIC PROJECT APPROVAL

Washington State Department of Fish & Wildlife

Introduction

All fish have habitat needs related to water quality, quantity, and to the other physical and biological features of the stream or body of water in which they live. For example, salmon and steelhead spawn and live for a time in a stream before going to the ocean. They require an ample supply of clean, cool, well-oxygenated water. Adults need clean gravel in which to spawn and juvenile fish require in-stream cover such as tree parts, boulders, or over-hanging banks to hide from predators. Vegetated stream banks shade the water from the warming effects of the sun. Insects drop off overhanging vegetation and provide food.

Construction activity in or near the water has the potential to kill fish directly. More importantly, this activity can also alter the habitat that fish require for a long time after the construction work is complete. Direct damage or loss of habitat results in a direct loss of fish production. Direct killing of fish is usually a one-time loss. Damaged habitat, however, can continue to cause lost production of fish for as long as the habitat remains altered. Major construction projects individually have a large potential for damage, but more habitat is lost from the cumulative effects of many smaller projects, each with a minimal level of impact.



The Law

All construction projects in State waters are governed by RCW 77.55. Known as the "Hydraulic Code", any person or government agency must first obtain an approval from the Washington Department of Fish and Wildlife (WDFW) before commencing work. Approval is given in the form of a Hydraulic Project Approval or "HPA". A "hydraulic project" is the performance of any work that will use, divert, obstruct, or change the natural flow or bed of any of the salt or freshwaters of the state. So, before installing a flood gate, dredging, or removing a beaver dam in a jurisdictional watercourse, a HPA must be obtained. Failure to obtain a HPA before engaging in any work within or above state waters, including drainage maintenance activities, is a gross misdemeanor. Every

person convicted of a gross misdemeanor defined in Title 9A RCW shall be punished by imprisonment in the county jail for a maximum term fixed by the court of not more than one year, or by a fine in an amount fixed by the court of not more than five thousand dollars, or by both such imprisonment and fine. Additionally, WDFW may levy civil penalties of up to one hundred dollars per day for violation of the Hydraulic Code. It is also a gross misdemeanor to violate any requirements or conditions of a Hydraulic Project Approval.

When is an HPA needed?

The law requires that any person, organization, or government agency wishing to conduct any construction activity that will use, divert, obstruct, or change the bed or flow of state waters must do so under the terms of a permit (called the Hydraulic Project Approval-HPA) issued by the Washington State Department of Fish and Wildlife. State waters include all marine waters and fresh waters of the state, except those watercourses that are entirely artificial, such as irrigation ditches, canals, and storm water run-off devices. The major types of activities in freshwater requiring an HPA include, but are not limited to: stream bank protection; construction or repair of bridges, piers, and docks; pile driving; channel change or realignment; conduit (pipeline) crossing; culvert installation; dredging; gravel removal; pond construction; placement of outfall structures; log, log jam, or debris removal; installation or maintenance of water diversions; and mineral prospecting. It is important to emphasize that the above are only examples of major types of activities requiring a HPA and that any construction activity that uses, diverts, changes, or obstructs the bed or flow of state waters requires a HPA. Approval of a permit is valid for a period of up to five years from the date of issuance.



Drainage maintenance on modified natural watercourses will require a HPA

How do I apply for a HPA?

The form to apply for a HPA is called a Joint Aquatic Resource Permit Application (JARPA). A JARPA consolidates seven permit application forms for federal, state, and local permits and is used to apply for a HPA and also for Water Quality Certifications or Modifications from the Department of Ecology, Aquatic Resource Use Authorizations from the Department of Natural Resources, and Army Corps of Engineers permits. The form can be found at <http://www.ecy.wa.gov/biblio/ecy07015.html>. Copies of the JARPA form must be submitted to all participating agencies that require a permit for your project, including the Department of Fish and Wildlife. There is no charge for the HPA. A similar JARPA for work on the Lummi Indian Reservation is also available.

A complete written application for a permit may be submitted in person or by mail and must contain the following:

1. General plans for the overall project.
2. Complete plans and specifications of the proposed work within the ordinary high water line in freshwater.
3. Complete plans and specifications for the proper protection of fish life.
4. Notice of compliance with any applicable requirements of the State Environmental Policy Act or other applicable laws.

Prior to JARPA review, State Environmental Policy Act (SEPA) compliance must be completed, usually by the Whatcom County SEPA official. SEPA is a Washington State policy that requires state and local agencies to consider the likely environmental consequences of a proposal before approving or denying the proposal. A "SEPA Checklist" can be obtained from Whatcom County Planning and Development Services. This checklist serves as a means to address all environmental issues associated with your project. Within 30 days of receiving your Checklist, the Whatcom County SEPA official will make one of three determinations:

1. DNS - A Determination of Non-significance means the project is unlikely to have a significant adverse environmental impact.
2. MDNS - A Mitigated Determination of Non-significance means the project may have some adverse impacts but that those impacts are mitigated for in the project proposal.
3. EIS - In cases where the risk of adverse environmental impacts are high, an EIS determination will be made, meaning the applicant must complete an Environmental Impact Statement for their project.

4. EXEMPTION - Some project proposals may receive a SEPA Exemption for small construction maintenance projects. Dredging projects of any size are not SEPA exempt.

The Washington State Department of Fish & Wildlife will grant or deny approval within forty-five calendar days of the receipt of a complete application and notice of compliance with any applicable requirements of the State Environmental Policy Act (SEPA). Protection of fish life is the only ground upon which approval of a permit may be denied or conditioned.



Fish excluded from a drainage maintenance project

- Fish distress and water quality - When water is present, Best Management Practices (BMPs) must be implemented to minimize immediate impacts to fish and to prevent the downstream release of sediment-laden water.
- BMP Factsheets #s 6-17 describe numerous BMPs necessary to protect fish and other natural resources.
- Habitat Improvement Projects designed to offset or “mitigate” for the negative impacts from work within the watercourse will likely be required and should be included in any permit application.

A pre-application or post-application site visit with a WDFW Habitat Biologist is usually arranged to review a proposed project. Drainage Improvement Districts in Whatcom County should have 5-year HPAs addressing all of their potential maintenance projects.

Note: Diking District #1 is located partially on the Lummi Indian Reservation and is subject to tribal laws for activities that occur on Reservation lands. The Lummi Nation Water Resources manager (360 384-2212) should be contacted regarding permitting requirements.

HPA Conditions for Drainage Maintenance Projects

Drainage maintenance projects must include measures designed to minimize negative impacts to natural resources. Some common conditions necessary for drainage maintenance work include:

- Work Window - the time period when the fewest fish are present and the streamflows are lowest. Unless otherwise noted, the work window is August 1 to September 30.

Typical Timing Windows	
Modified Watercourses	August 1 to September 30
Dry Constructed Watercourses	Anytime watercourse is dry
Wet Constructed Watercourse	August 1 to October 30

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WATER POLLUTION CONTROL ACTS

Drainage Maintenance Regulations

Introduction

Agriculture is a major contributor to the State's economy and has an equally important role in affecting the quality of the State's surface water. Agriculture's role in affecting water quality is important because the surface waters upon which our communities rely for beneficial uses such as irrigation, fish habitat, domestic use, livestock watering, recreation and manufacturing either originate or are affected by the rivers, creeks and ditches that flow through agricultural lands. Most of these agricultural lands were historically forest lands.

This water eventually finds its way into the Puget Sound or the Strait of Georgia. Recently, the decline of water quality has been so pronounced that there is a new "community effort of citizens, governments, tribes, scientists and businesses working together to restore and protect Puget Sound". To achieve these important goals, farmers will have to join with this new alliance.

The Laws

Clean Water Act 33 USC § 1251 et seq. and Washington State Water Pollution Control Act 90.48 RCW and Lummi Nation Water Resources Protection Code (Title 17) for Lummi Indian Reservation Lands. The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The basis of the CWA was enacted in 1948 and was called the Federal Water Pollution Control Act. It was significantly reorganized and expanded in 1972 and became known as the "Clean Water Act" (CWA) with the amendments of 1977.

Under the CWA, it is unlawful to discharge any pollutant from a point source into navigable waters, unless a permit is first obtained. Additionally the U.S. Environmental Protection Agency (EPA) has set water quality standards for all contaminants in surface waters. It has also set wastewater standards for industry. The standards describe how much pollution can be allowed after All Known And Reasonable Technologies (AKART) have been applied. Point sources are discrete

conveyances such as pipes and man-made ditches.

Under Section 404 of the CWA, a Department of Army Corp of Engineers (ACOE) permit is normally required for the discharge of dredged or fill material into the waters of the U.S. "Waters of the U.S." include navigable and interstate waters, their tributaries, and certain adjacent and abutting wetlands. An exception to this requirement is where the discharge is incidental to maintenance but not construction of drainage ditches. Before an ACOE permit can be issued the Washington Department of Ecology (WDOE) or the Lummi Nation (for work on Lummi Indian Reservation Lands) must "certify" that the proposed work complies with the applicable provisions of the CWA and applicable state or tribal laws. Failure to obtain a permit under the CWA can result in civil penalties up to \$25,000 per day and fines of \$10,000 per incident.



Drainage Maintenance can be a significant source of sediment release

WDOE and the Lummi Nation have been delegated authority from EPA to implement certain sections of the CWA. The WDOE is also charged with implementing the State's Water Pollution Control Act (WPCA). The effect of these two laws is the extension of water quality standards to surface and ground waters. The water quality standards are established to sustain public health and public enjoyment of the waters and the propagation and protection of fish, shellfish, and wildlife. Whether or not dredging requires an ACOE discharge permit,

Action Agenda For Puget Sound

Water quality standards have proven to be inadequate in and of themselves to protect Puget Sound. Beginning in 1987 a series of management plans were developed to coordinate actions of Federal, State, Local and Tribal governments to stem the declining water quality of the Sound. Twenty years later and faced with the continued serious decline “as indicated by loss of and damage to critical habitat, rapid decline in species populations, increases in aquatic nuisance species, numerous toxics contaminated sites, urbanization and attendant storm water drainage, closure of beaches to shellfish harvest due to disease risks, low-dissolved oxygen levels causing death of marine life, and other phenomena” the legislature created a new agency through passage of RCW 90.71.

Known as the Puget Sound Water Quality Protection Act, an “Action Agenda” is being crafted to recover and protect Puget Sound. The action agenda is to consist of the goals and objectives expressed in the legislation including implementation strategies to meet measurable outcomes, benchmarks, and identification of responsible entities. All governmental entities within Puget Sound are expected to exercise their existing authorities to implement the applicable provisions of the action agenda. Since drainage systems can convey nutrients, pathogens, sediment and other pollutants, it is reasonable to expect that Drainage Improvement District activities will come under close scrutiny by this new agency in the near future as the Action Agenda is developed and implemented.



the activity cannot result in a violation of water quality standards. If maintenance activities do not follow AKART and generate pollution, it can result in a fine or penalty of \$10,000 per day. Water quality standards that are commonly exceeded due to drainage activity include temperature and turbidity. Where pollution already exists in the “background”, it need not be controlled or improved. However, you must avoid increasing pollution beyond a specified amount. By incorporating appropriate BMPs and procedures in your DMP and by following the BMPs in the field, one can avoid problems with the CWA, WPCA, and tribal laws and meet the goals of the Puget Sound Partnership. *Factsheet #16 Water Quality Protection Measures, Factsheet #19 Drainage Water Quality and Factsheet #22 Farm Practices* provide detailed information on how to farm and maintain drainage without running afoul of water quality standards.

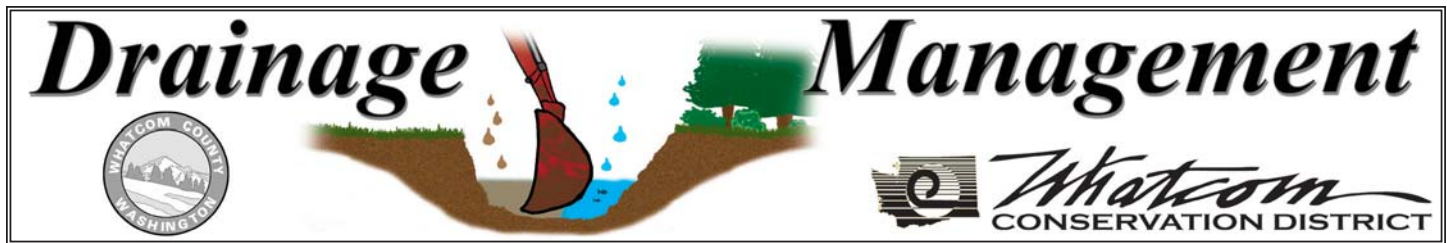
In 1987, Congress changed the federal Clean Water Act by declaring the discharge of stormwater from certain industries and municipalities also be regulated. Due to this change, certain stormwater discharges now require a National Pollutant Discharge Elimination System (NPDES) permit or water quality discharge permit. The U.S. Environmental Protection Agency (EPA) delegated the Department of Ecology the authority to implement these permits in Washington State in two phases.

In Phase I, only certain industries, large construction sites, and a few of the largest municipalities were required to have an NPDES permit. The Phase II regulations expanded the requirement for NPDES stormwater permits. This potentially sweeps within its requirements special purpose districts (such as a Drainage Improvement District) when boundaries cross into a city or county jurisdiction subject to a Phase I or Phase II stormwater permit.

Additionally, a third party can petition WDOE to determine that the DID is a significant contributor of pollution to surface waters. Note that the DID need only be the conduit and not the generator of the pollution. So, DIDs should work closely with landowners to ensure that their operations result in clean water leaving their lands and entering into the drainage system.

With a designation of a DID as a “significant contributor of pollution”, it must develop a stormwater program that addresses the following six main elements:

- Public Education and Outreach
- Illicit Discharge Detection and Elimination
- Post-Construction Runoff Control
- Public Participation/Involvement
- Construction Site Runoff Control
- Pollution Prevention/Good Housekeeping



Permitting Factsheet #3

GROWTH & SHORELINES MANAGEMENT ACTS (Whatcom County Critical Areas Ordinance)

Shorelines Management Act 90.58 RCW

Recognizing that the shorelines of the state are among our most valuable and fragile natural resources, the State Legislature passed the Washington State Shoreline Management Act (SMA) in June 1971. The SMA was overwhelmingly passed by public initiative in 1972. Under the SMA, each county and city was required to prepare a shoreline “master program” in accordance with the shoreline guidelines issued by the State Department of Ecology in 1972.

The Whatcom County Shoreline Management Program (SMP), WCC Title 23, is the document that implements the goals and policies of the SMA at the local level. It was adopted in 1976. Under the provisions of the SMA, all development within shorelines of the state is required to comply with the provisions of local shoreline master programs. Drainage maintenance activities may be considered “development” or may be exempt under some circumstances. Whatcom County jurisdiction includes stream channels and all associated wetlands, floodways and upland areas within 200 feet of the Ordinary High Water Mark (OHWM).

Whatcom County Planning and Development Services (PDS) and the Washington State Department of Ecology (DOE) share joint authority and responsibility for the Whatcom County SMP. PDS is the primary agency responsible for implementation of the Whatcom County SMP. DOE is responsible for supervising the administration of the code, ensuring proper implementation, and assuring consistency with the SMA. Because the Whatcom County master program is approved and adopted by DOE, it has the authority of state law.

Growth Management Act 36.70A RCW

In 1990, the Growth Management Act (“GMA”) was enacted by the State legislature in response to rapid population growth and concerns with suburban sprawl, environmental protection, quality of life, and related issues. Whatcom, along with twenty-six other counties, was required to adopt county-wide planning policies

that protect “critical areas” and existing “shoreline values”. Critical areas that may be impacted by drainage maintenance activities include wetlands and Habitat Conservation Areas (“HCAs”). The standard protection for wetlands range from 25 feet to 300 feet depending upon the type of activity and level of function of the wetland. The buffer widths for streams range from 50 feet for non-fish bearing streams, to 100 feet for fish bearing streams and 150 feet for shoreline streams. These standard buffer widths may be reduced with a Farm Conservation Plan or for Drainage Improvement Districts a Drainage Maintenance Plan. Failure to comply with the County’s CAO can result in an stop work order and a civil offense punishable by \$1,000 fine for each offense. Each day of work constitutes a separate offense.

Drainage maintenance activities are allowed only after Notification to the Whatcom County critical areas Technical Administrator 10 days prior to initiating work provided that all the following are met:

1. The maintenance is necessary to support ongoing agricultural operations;
2. The maintenance activity does not expand the dimensions of the drainage channel beyond the original, lawfully established dimensions;
3. The agricultural activities are conducted pursuant to an approved farm conservation plan or drainage management plan;
4. The project proponent or landowner obtains a Hydraulic Project Approval (HPA), if required from the Washington Department of Fish and Wildlife (WDFW), prior to the maintenance activity;
5. The project proponent or landowner provides a copy of the HPA to the Technical Administrator as part of the written notification. No other written notification is needed.

Whatcom County permit applications and notices necessary to perform drainage maintenance are likely to include:

- State Environmental Policy Act checklist
- Natural Resource Notification of Activity
- Endangered Species Act (ESA) Checklist for Development within the ESA Potential Impact Area

WHATCOM COUNTY

Planning & Development Services
5280 Northwest Drive,
Bellingham, WA 98226-9097
360-676-6907, TTY 800-833-6384
360-738-2525 Fax



David Stalheim
Director

J.E. "Sam" Ryan
Assistant Director

NATURAL RESOURCE NOTIFICATION OF ACTIVITY

Date _____

Notice of work to be performed in or near a Critical Area or Water Resource Special Management Area in compliance of the Whatcom County Code 16.16.235 and 20.80.735. This Notification should be submitted to the Whatcom County Planning and Development Services at least 10 working days before proposed starting date. No work shall be initiated until after 10 days of submittal of form. Review of this proposed activity may result in the requirement for a permit such as land disturbance, shoreline, etc. You will be notified if permits will be required for the proposed activity.

Contractor _____

Phone _____

Address _____

Property owner _____

Phone _____

Address _____

Property Address and Tax Parcel Number _____

Proposed start date _____

Proposed finish date _____

Type of affected Critical Area and/or watershed _____

Describe activity to be conducted (if more space is needed attach additional information sheets). Provide a site plan with this notification. Clearly identify location of proposed activity on the site.

I / We understand this work and/or activity may have adverse effects on the Critical Area and/or watershed processes, and acknowledge that special care must be taken to reduce or eliminate adverse effects. Effective sediment and erosion control measures must be installed and disturbed areas shall be restored as near as possible to the previous condition.

Description of sediment erosion control measures and/or restoration _____

I / We the undersigned acknowledge and except the responsibility for the progress and completion of this project. Any unforeseen problems or plan changes will immediately be brought to the attention of the County Technical Administrator.

Signed _____ Date _____ Signed _____ Date _____

FOR AGENCY USE

Approved _____ Date _____

Additional Information/permits required _____

AGENCY CONTACT REQUIREMENTS

Watercourse Classification	Activity	Description	No Agency Contact	WC Natural Resource Notification	WC ESA Checklist	WDFW HPA Needed	Ecology Stormwater Notification	Ecology Permit	Army Corps of Engineers
Constructed Watercourse	Maintenance Dredging	Removal of channel bottom sediments	X						
	Watercourse Bank Vegetation Management	Mow noxious weeds	X						
	Culvert Maintenance	Debris removal or headwall repair	X						
	Bridge Maintenance	Debris removal or abutment repair	X						
	Herbicide Applications	Aquatic herbicide applications	X					X	
	Beaver Dam Removal	Modify or remove beaver dam	X						
	Sediment Trap Maintenance	Remove sediments	X						
	Hand Maintenance	Vegetation removal	X						
Modified Watercourse	Maintenance Dredging	Removal of channel bottom sediments		X	X	X	X	X	X
	Watercourse Bank Vegetation Management	Mow noxious weeds		X		X			
	Culvert Maintenance	Debris removal or headwall repair		X	X	X		X	X
	Bridge Maintenance	Debris removal or abutment repair		X		X		X	X
	Herbicide Applications	Aquatic herbicide applications		X				X	
	Beaver Dam Removal	Modify or remove beaver dam		X	X	X			
	Sediment Trap Maintenance	Remove sediments		X	X	X	X	X	X
	Hand Maintenance	Vegetation removal		X	X	X			

WC - Whatcom County

WDFW - Washington Department of Fish and Wildlife

Ecology - Washington State Department of Ecology

ESA - Endangered Species Act

AGENCY AND ORGANIZATION CONTACTS

FEDERAL AGENCIES

US Army Corps of Engineers
Seattle District Regulatory Branch
PO Box 3755
Seattle, WA 98124-2255
Telephone: (206) 764-3495
Fax: (206) 764-6602

Natural Resources Conservation Service
Lynden Service Center
6975 Hannegan Road
Lynden, WA 98264-9019
Phone: (360) 354-5658
Fax: (360) 354-4678

Whatcom County Public Works
Stormwater Division
2011 Young Street, Suite 201
Bellingham, Washington, 98225
Telephone: (360) 715-7450
Email: WaterResources@co.whatcom.wa.us

Whatcom County Public Works
Noxious Weed Control Board
901 W. Smith Road
Bellingham, Washington
(360) 354-3990,
Email: LBaldwin@co.whatcom.wa.us

WASHINGTON STATE AGENCIES

Washington Department of Fish & Wildlife
WDFW, Region 4
Area Habitat Biologist
P.O. Box 1100
La Conner, WA 98257
(360) 466-4345
<http://wdfw.wa.gov/>

Washington Department of Ecology
Bellingham Field Office
1440 10th Street, Suite 102
Bellingham, WA 98225
360-715-5200
<http://www.ecy.wa.gov/>

Whatcom Conservation District
6975 Hannegan Rd
Lynden, WA 98264
(360) 354-2035 x3
www.whatcomcd.org

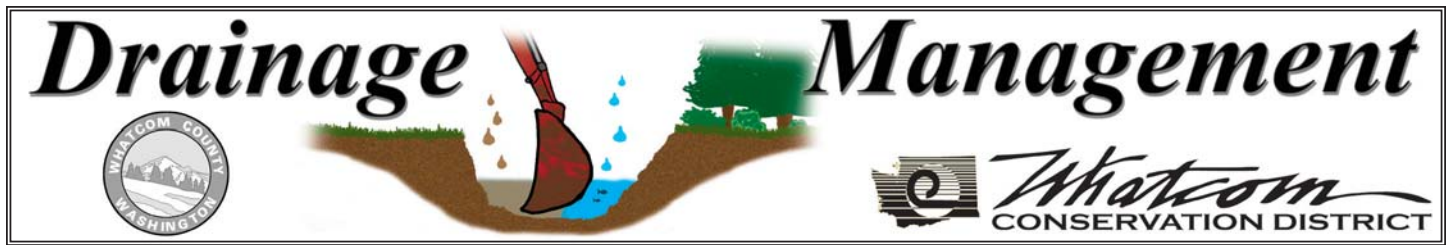
NON GOVERNMENTAL ORGANIZATIONS

Nooksack Salmon Enhancement Association
2445 East Bakerview Road
Bellingham, WA 98226
(360) 715-0283
<http://www.n-sea.org>

LOCAL

Whatcom County Planning and Development Services
5280 Northwest Drive
Bellingham, Washington 98226
Telephone: (360) 676-6907
Email: pds@co.whatcom.wa.us

Whatcom County Public Works
River & Flood Division
322 N. Commercial Street, Suite 120
Bellingham, WA 98225
Telephone: (360) 676-6876
Email: RiverFlood@co.whatcom.wa.us



Permitting Factsheet #5

Emergency Drainage Maintenance

Introduction

Circumstances will arise as a result of weather or other factors where drainage maintenance work must be done outside of designated work windows and/or require the actions that deviate from the Best Management Practices (BMPs) in a Drainage Management Plan (DMP). In the event of a drainage maintenance emergency, the following protocols will apply:

Constructed Watercourses

Notification to the Washington Department of Fish and Wildlife (WDFW), Whatcom County Planning and Development Services (WCPDS) and U.S. Army Corps of Engineers (ACOE) is not required for emergency repair activities in constructed watercourses identified in a Drainage Improvement District's (DID's) DMP. BMP implementation is voluntary but careful monitoring of water quality is necessary to ensure downstream waters are not impacted.

Factsheet # 16 Water Quality Protection Measures

Modified Natural Watercourses

Emergency approval is required by WDFW and emergency notification is required to ACOE (when an ACOE permit was required) for any emergency repair activities occurring in Modified Natural Watercourses identified in a DID's DMP.

WDFW Emergency Contacts:

Jeff Kamps (Area Habitat Biologist) -

(360) 466-4345 Ext. 271

Brendan Brokes - (360) 466-4345 Ext. 253

Emergency Hotline - (360) 902-2537

In most cases WDFW will issue a verbal emergency maintenance approval, with the understanding that the proposed work is necessary to address emergency drainage conditions. The DID will schedule an on-site meeting with the WDFW Area Habitat Biologist as soon as possible, but not more than 30 days after work is completed. The purpose of this on-site meeting will be to determine if additional measures will be necessary to restore fish habitat that may have been damaged as a

result of an emergency action undertaken by the DID.

ACOE Emergency Contacts:

(for DIDs with watercourses needing a ACOE permit)

Randel Perry - Skagit/Whatcom and FERC/Special

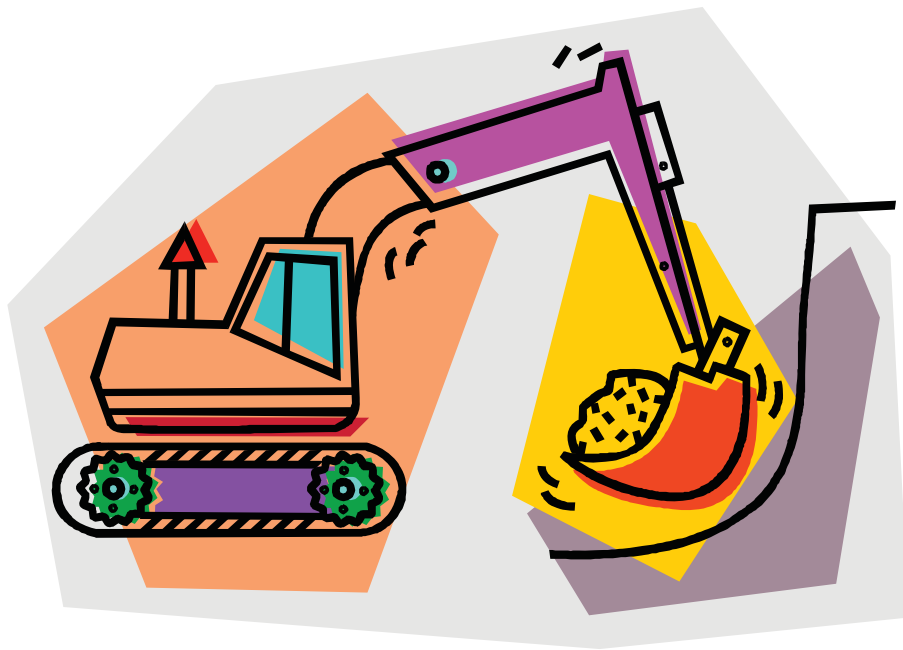
Assignment - (206) 764-6985

FAX number - (206) 764-6602

1. Make sure you make a good faith effort to contact the Corps Regulatory Branch before proceeding with work, i.e., at least leave a voice mail and fax stating whatever information you have available. The fax number for everyone located in the main office in Seattle is (206) 764-6602. If a permit is required and no contact was made, we could consider the work a knowing and willful violation.
2. Information to give the Corps - if you are unable to speak with someone directly, leave as much of the following information on voice mail and follow up with more details as soon as possible.
 - Where the work is located (highway, river mile, nearest waterbody, nearest city, etc.).
 - What work is being performed (replacement of lost riprap, bank protection, replacement of lost uplands, large woody debris being placed, cleaning of a culvert, etc.).
 - Include a discussion (amounts, location, etc.) of any temporary fill/work, when the material will be removed, and how the area will be restored.
 - How the work is being performed (clean excavation with backhoe, pushing of material with bulldozer, blasting out the culvert with water, etc.).
 - If any of the proposed work is in wetlands or below the plane of ordinary high water (freshwater) or below the plane of mean higher high or mean high water (tidal).
 - Relationship of the proposed work to previously existing structures (replacing what previously existed or adding different structures, etc.).
 - Photos, if available, can often be very helpful.
 - Anything else that could help us to determine what is being proposed (reference previously issued permits for work at the site).
 - Include what coordination with the NMFS/USFW (Services) for ESA/EFH has occurred.

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Best Management Practices Factsheets



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General Drainage Maintenance BMPs

Introduction

Drainage Maintenance work such as dredging, mowing or beaver dam removal will have negative impacts to natural resources. Best Management Practices (BMPs) have been developed to minimize the environmental impacts. This Factsheet contains general BMPs that should be used when implementing any type of drainage maintenance project. BMP Factsheets #7 to #17 describe additional BMPs needed for specific types of drainage maintenance work.

BMPs

1. Operate equipment only from the top of the channel bank. Watercourse crossings are not allowed.
2. Equipment shall not enter or cross the channel when water is present.
3. Existing vegetation shall be retained on the sidewalls of the channel to the maximum extent possible.
4. Work will take place from the north or east banks whenever possible.
5. Disturbance of the channel banks and woody stem riparian vegetation shall be held to the absolute minimum necessary to access the channel and to conduct the drainage maintenance activity.
6. Disturbance of woody stem riparian vegetation shall be limited to one side of the channel at any given location along the watercourse.
7. Along the shoreline, disturbed soils at risk of entering the watercourse shall be protected from erosion using vegetation and/or other means.
8. Dredged, excavated, or bucket mowed materials shall be deposited landward of the top of the channel bank.
9. Dredged, excavated, or bucket mowed materials shall not be stockpiled below the top of the channel bank.
10. Project activities shall be conducted in a way that minimizes the introduction of silt-laden water into the watercourse.
11. Pilings or lumber treated with creosote or pentachlorophenol shall not be used for project construction.
12. All treated wood shall be professionally treated and completely cured prior to installation below the high water line in order to minimize leaching into the water or substrate.
13. Wet concrete shall be prevented from entering the watercourse. Footings, foundations and/or super structures constructed with fresh concrete shall be sufficiently cured prior to contact with water to avoid leaching. Forms and impervious materials shall remain in place until the concrete is cured.
14. All debris or deleterious material resulting from drainage maintenance activities shall be removed from the watercourse and prevented from re-entering the channel.
15. No petroleum products or other deleterious materials shall be allowed to enter the surface waters in the channel.
16. If a fish kill occurs or fish in distress are observed, in-water drainage maintenance activities shall immediately cease and the Area Habitat Biologist (AHB) shall be immediately contacted.
17. Removal of trash and plant debris blocking culverts, bridges, and floodgates shall not be subject to a timing limitation.
18. Whenever rock is used to armor the channel bank in the immediate vicinity of a drainage structure (culvert, floodgate, bridge, pump facility), the rock shall be composed of clean, angular material of a sufficient durability and size to prevent its being broken up or washed away by high water.
19. The footprint of a maintained, repaired or replaced drainage structure (culvert, floodgate, bridge, pump facility, trash rack) below the high waterline shall not exceed the footprint of the original drainage structure below the high waterline.
20. Emergency work that must be done outside the normal work window of August 1 to September 30 must be verbally approved by the AHB prior to implementation.

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Maintenance Dredging Best Management Practices

Introduction

Maintaining drainage by dredging is a common and proven method to remove nuisance vegetation and accumulated sediments. Dredging is also the practice with the most negative impacts to natural resources. Fish, fish habitat and water quality are significantly impacted during and after dredging. *Informational Factsheets #20 Watercourse Re-vegetation and #22 Farm Practices* suggest methods that will prevent sediments and nuisance vegetation from impacting the watercourse, thereby reducing the need for dredging.

Additionally, BMP Factsheet #15 Fish Protection and Factsheet #16 Water Quality Protection Measures provide detailed Best Management Practices (BMPs) to minimize impacts to fish and water quality during dredging. The following general BMPs apply to all maintenance dredging work:



Temporary silt fence

Dredging BMPs

General BMPs

1. **Timing Limitations:** Whenever water is present in the channel, maintenance dredging below the waterline shall only occur from August 1 through September 30 of any year for the protection of migrating juvenile and adult salmon.
2. **NOTIFICATION REQUIREMENT:** A representative of the Drainage Improvement District or contractor shall notify the Washington Department of Fish and Wildlife Area Habitat Biologist (AHB) of the project start date. Notification shall be received by the AHB prior to the start of dredging activities. Note: This notification assumes that the DID has obtained all appropriate permits prior to work.
3. Dredging shall be conducted with hand tools and/or a tracked excavator equipped with a clam shell or lidded bucket to minimize fallback.
4. Each pass with the excavator bucket in the channel shall be complete.
5. Dredging shall be held to the absolute minimum necessary to achieve the target channel width, depth and gradient.
6. The channel banks shall be sloped such that the resulting channel banks are stable.
7. Maintenance dredging shall not straighten or shorten the existing channel alignment.
8. Existing large woody material embedded in the channel bank or streambed shall be left undisturbed and intact.



Lidded bucket on tracked excavator

Silt Management

9. When water is present in the channel, maintenance dredging activities in and immediately upstream of a watercourse reach that has been identified as juvenile salmonid rearing habitat in the Drainage District's Drainage Maintenance Plan shall implement silt management provisions 10 through 14.
10. Prior to initiating maintenance dredging activities, a temporary silt fence shall be installed immediately downstream of the watercourse reach to be dredged. The temporary silt fence shall be installed across the watercourse and perpendicular to the water flow.
11. The temporary silt fence shall remain in place for the duration of the maintenance dredging activity.
12. If watercourse flows are encountered that exceed the design capacity of the silt fence, the maintenance dredging activity shall stop until the watercourse flows subside.
13. Prior to the removal of the temporary silt fence from the watercourse, silt that has accumulated behind the silt fence shall be removed to the greatest extent possible.
14. The temporary silt fence shall be removed within 2 days of completing the maintenance dredging activity.

BMP Factsheet # 16 Water Quality Protection Measures provides detailed information on sediment management.

Fish Removal

15. When water is present in the channel, the provisions in *BMP Factsheet #15 Fish Protection* shall be implemented prior to initiating maintenance dredging activities in watercourse reaches that have been identified as juvenile salmonid rearing habitat in the Drainage District's Drainage Maintenance Plan.



Fish removal

Drainage Management



BMP Factsheet #8

BEAVER DAM MANAGEMENT

Introduction

Beavers are North America's largest rodent and perhaps are second only to humans in their ability to alter the environment. Beaver dams can cause drainage problems on managed watercourses and impounded water can cause property damage.

Pursuant to RCW 77.55 a permit must be issued for work that will use, obstruct, change, or divert the bed or flow of state waters. To remove or modify a beaver dam on a natural or modified watercourse, you must have a Hydraulic Project Approval (HPA) issued by the Washington Department of Fish & Wildlife (WDFW). In emergency situations (when an immediate threat to property or life exists), verbal approval from WDFW may be obtained for work necessary to solve the problem. A Drainage Improvement District may hold a five year HPA covering beaver dam management as a component of their Drainage Management Plan.

Beaver pelts were once integral to the economy of North America, until beavers were nearly trapped out of existence in the late 1700s and early 1800s when demand for their pelts peaked in Europe. Beaver populations rebounded in the 1900s but remained at relatively low and stable levels due to sport and commercial trapping influence. In 1998 and 1999 beaver pelt prices fell dramatically, eliminating incentives for commercial trappers. Concurrently, a trapping initiative was passed in Washington banning leg hold traps. Sport trappers proved unwilling to use livetraps so beaver populations have grown steadily, largely unchecked since the late 1990s.

Beavers eat a wide variety of plants including grasses, pond lilies, cattails,



corn, other herbaceous plants, and a variety of woody plants. Beaver dams create habitat for many animals and plants and provide essential habitat for juvenile salmon, particularly Coho. In winter, deer and elk frequent beaver ponds to forage on shrubby plants that grow where beavers cut down trees for food or to use in making their dams and lodges. Weasels, raccoons, and herons hunt frogs and other prey along the marshy edges of beaver ponds. Migratory waterbirds use beaver ponds as nesting areas and resting stops during migration. Ducks and geese often nest on top of beaver lodges, since they offer warmth and protection, especially when lodges are formed in the middle of a pond. The trees that die as a result of rising water levels attract insects, which in turn feed woodpeckers, whose holes later provide homes for other wildlife. Additionally, beaver ponds collect and slowly release stormwater and are a natural means of flood control and groundwater recharge.

In some situations it may make more sense to accommodate beavers and their dams rather than attempt to remove them. Low lying marginal farmlands may be more productive as beaver wetlands and could be enhanced through the Conservation Reserve Enhancement Program or other programs.

Beaver Control

The beaver is classified as a furbearer (WAC 232-12-007). A trapping license and open season are required to trap or shoot a beaver. The property owner, the owner's immediate family, an employee, or a tenant of property may shoot or trap a beaver on that property if a threat to crops exists (RCW 77.36.030). In such cases, no special trapping permit is necessary for the use of live traps. However, a special trapping permit is required for the use of all traps other than live traps (RCW 77.15.192, 77.15.194; WAC 232-12-142). There are no exceptions for emergencies and no provisions for verbal approval. All special trapping permit applications must be in writing on a form available from the WA Department of Fish and Wildlife (WDFW).

Beaver Dam Management on Modified Watercourses

Where unacceptable flooding is affecting property (including agricultural fields) or roads, dam modification or removal should be considered. While dam removal is an option, it can be very frustrating and ineffective if the beavers repair the breach very quickly.

Not all beaver problems can or should be handled the same way. Flow control devices and beaver deceivers may be more effective than continued maintenance of beaver dams or the outright removal of beavers and their dams. The important feature of these techniques is to reduce the beavers' dam building instinct in response to the sound of running water.

dam or pond, the installation of sediment control measures will be necessary. See *Factsheet #16 Water Quality Protection Measures*.



Dam breach

Beaver Dam Modification and Removal BMPs

- Dams can be removed during the work window of August 1st to September 30th using a Drainage Improvement District's (DID) five year permit.
- Dams needing removal outside the work window or on land outside a DID require prior contact with the Washington State Department of Fish and Wildlife (WDFW) Area Habitat Biologist (AHB) and a Critical Areas notification to Whatcom County. See *Permitting Factsheets #1 - 5* for more information.
- Remove dam materials slowly and by hand or with hand tools to the extent possible. Chain saws and winches can be used to dislodge and remove material.
- If large equipment is needed it must be stationed at the top of the bank, road or bridge. See *BMP Factsheet #6* for general BMPs.
- If large woody material 6 feet or longer and 4 inches or greater in diameter is embedded in the streambank it shall be left undisturbed.
- The water level should drop by no more than 1" per hour and 12" in 24 hours.
- Remove enough dam material to reach the desired water level and to ensure that the dam location does not generate more running water sounds than the rest of the channel. The sound and feel of rushing water triggers the dam building instinct in beaver and may well result in a new dam constructed in the same area.
- Monitor the upstream and downstream for signs of stranded or stressed fish. If a fish kill occurs or fish are observed in distress, cease work immediately and contact the AHB. Then implement Fish Protection BMPs before additional dam work is completed. See *BMP Factsheet #15 Fish Protection*.
- Monitor downstream for turbidity and sedimentation. If suspended sediments are being released from the

Beaver Dam -- Flow Control Devices

- The water level can also be managed by installing a "flexible leveler" (Figure 1). The advantages include maintaining an acceptable pond level, not risking the repair of dams or construction of new dams nearby and not displacing the beaver family.
- Maintain at least a 3' pond depth so that the beaver colony will stay rather than move elsewhere and potentially cause other problems.
- The pipe should extend at least 10' upstream and downstream of the dam and be of adequate size (usually 4" to 12") to convey enough water flow to maintain the desired water level.
- The upstream end should be protected with a wire cage made of 6"x8" welded steel cattle panels to prevent plugging and noise. The cage should remain submerged to prevent the beaver from plugging the wire mesh.
- This type of device is only effective if small flows through the dam are required. They will not provide effective drainage where large flows are required.



Flexible Leveler at Tennant Lake

Beaver Deceivers

- To a beaver, a culvert probably looks like a hole in an otherwise fine dam. Beavers will almost always try to dam these holes.
- Rather than continuing to remove dam materials, a beaver deceiver may be a permanent solution needing very little maintenance (Figure 2).
- Construct in a trapezoidal shape with 10' to 16' side lengths.



Beaver Deceiver on Schneider Ditch

- Construct with 6"x8" welded steel cattle panels to maximize fish passage.
- Monitor regularly for maintenance needs.

Note: Flow Control Devices and Beaver Deceivers may have negative impacts to fish passage. Consult the WDFW Area Habitat Biologist for site specific BMPs prior to any installation.

Beaver Dam Management on Constructed Watercourses

Beaver dams less than one year old on a constructed watercourse may be removed or modified as needed using the methods listed above. If the dam has been in place for a number of years, then the pond, adjacent riparian areas and the downstream channel are often considered valuable fish and wildlife habitat. In most cases a Whatcom County Critical Areas notification will be needed prior to any dam modification or removal. See *Factsheet #3 Growth & Shorelines Management Acts*.

Figure 1

FLEXIBLE LEVELER

SNOHOMISH COUNTY PUBLIC WORKS

ADAPTED FROM SKIP LISLE (2001)

DRAWN BY: D. LUCAS

DATE: 11-14-01, REVISED 9-1-02

CONTACT: JAKE JACOBSON 425-388-3464 X6428

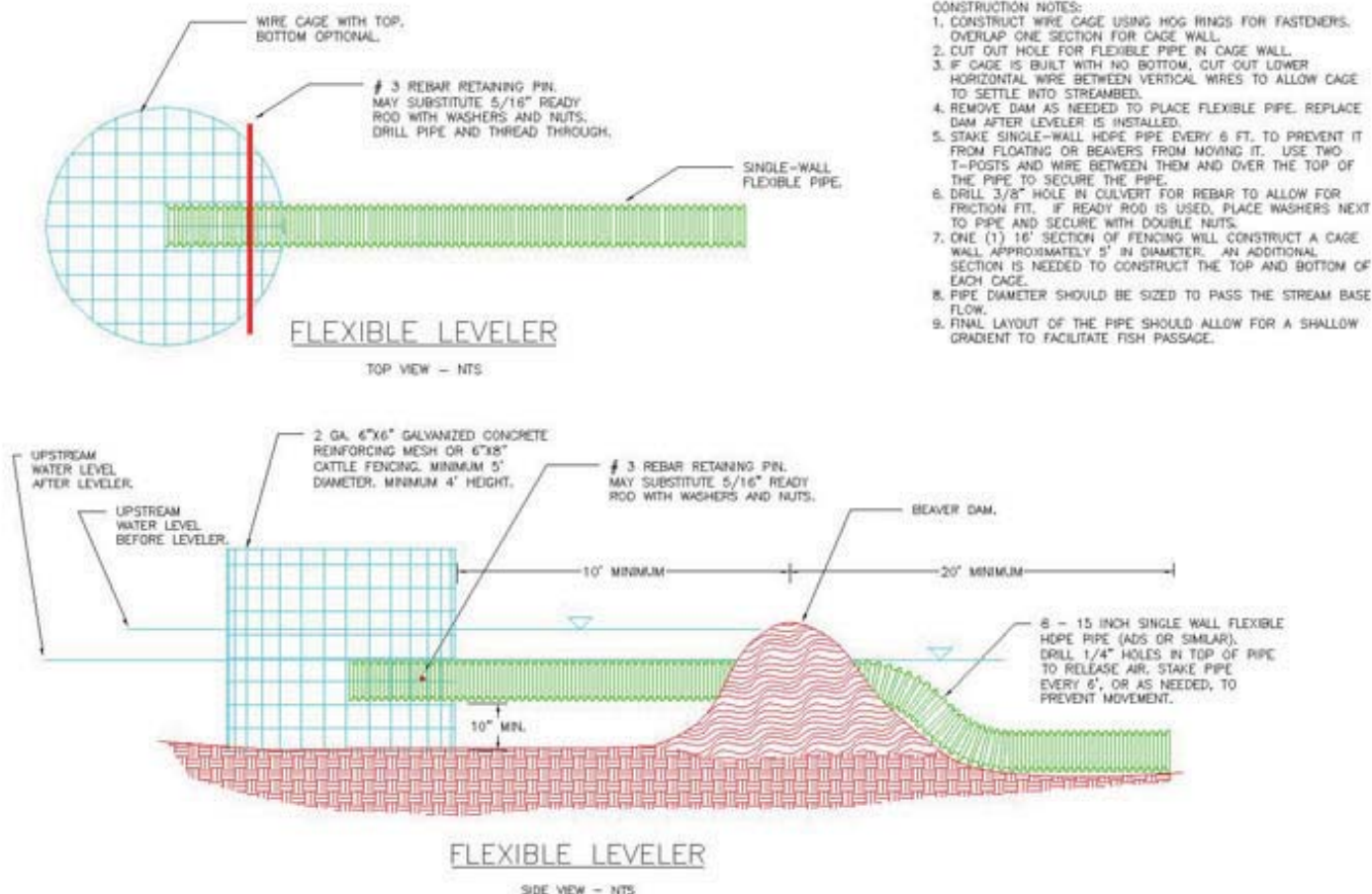


Figure 2

BEAVER DECEIVER

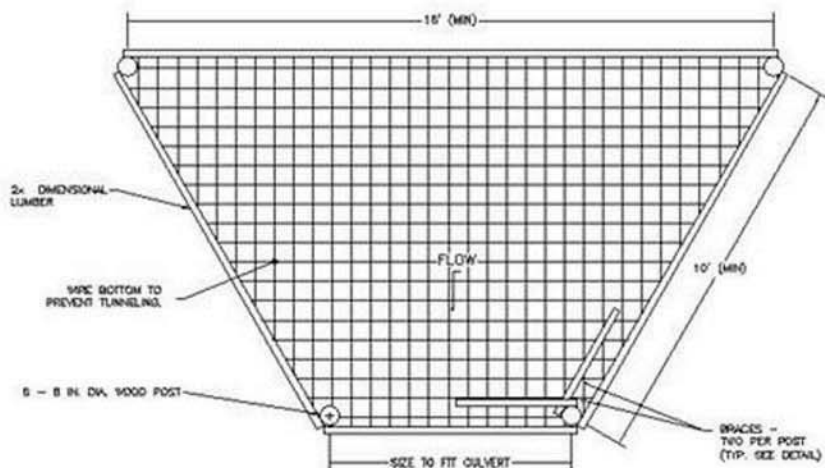
SNOHOMISH COUNTY PUBLIC WORKS

ADAPTED FROM SKIP LISLE (2001)

DRAWN BY: D. LUCAS

DATE: 11-14-01, REVISED 12-3-04

CONTACT: JAKE JACOBSON 425-388-3464 X6428



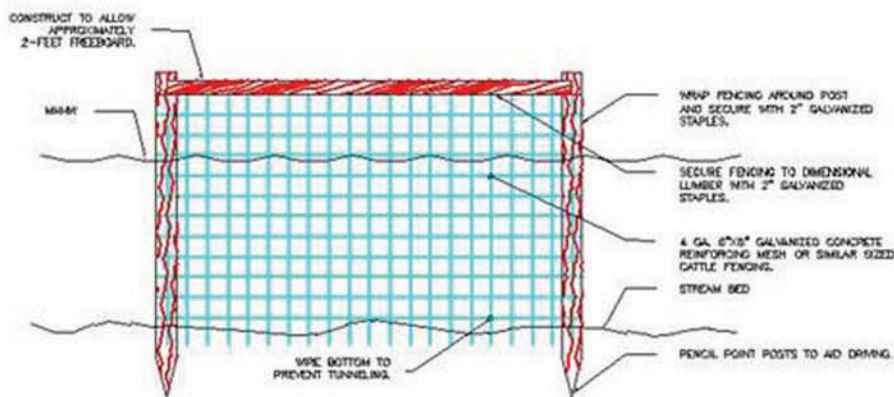
NOTE:
1. THIS DESIGN ONLY ADDRESSES THE INLET OF A CULVERT. THE INSTALLER SHOULD ALSO GUARD THE PIPE OUTLET TO PREVENT BEAVERS FROM ENTERING AND BLOCKING THE FLOW. THERE ARE NUMEROUS METHODS AVAILABLE AND IT IS LEFT TO THE INSTALLER TO PICK A DESIGN.

BEAVER DECEIVER

PLAN VIEW - NTS

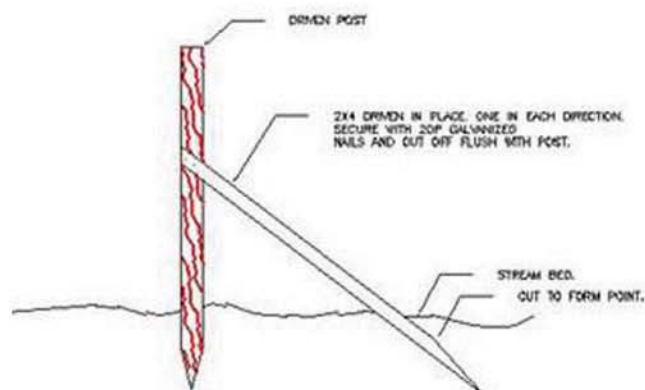
BEAVER DECEIVER

SIDE VIEW - NTS



BEAVER DECEIVER

SIDE VIEW - NTS



BEAVER DECEIVER

POST BRACE DETAIL - NTS

Drainage Management



BMP Factsheet #9

WATERCOURSE VEGETATION MANAGEMENT

Introduction

Maintaining vegetation on watercourse channel banks and in the watercourse may be an inexpensive and effective way to maintain drainage. However the removal of vegetation and dead vegetation left in the watercourse can be detrimental to water quality and to fish habitat.

Please remember:

- All types of plants growing near waterways can provide shade. This shade can reduce water temperatures and provide fish habitat.
- Vegetation roots are an invaluable means to stabilize stream banks and prevent erosion.
- Steep channel banks can be destabilized by aggressive mowing or herbicide use. Resulting erosion can both inhibit good drainage and degrade fish habitat and water quality.
- There is a **big** difference between maintaining grass, blackberries or noxious weeds along the channel and doing anything to adversely affect native trees and shrubs that can have significant benefit to water quality, fish habitat and to drainage.
- Mowing vegetation of any kind on the channel bank below the Ordinary High Water Mark will require a Hydraulic Project Approval (HPA) from the Washington State Department of Fish and Wildlife (WDFW).
- Mowing vegetation within the standard Critical Areas buffer requires notification to Whatcom County prior to work.

- *Permitting Factsheet #1 Hydraulic Project Approval and #3 Growth and Shorelines Management Acts* provide detailed information on permitting requirements.



General Mowing BMPs (Grass and Blackberry)

1. Remove mowed material from the watercourse so it does not reduce drainage efficiency.
2. Prevent mowed material from reentering the channel, as the decay of material can lower oxygen levels in the water downstream, thereby harming fish.
3. Continual mowing becomes quite expensive over time. Often this practice is done in advance of more long term solutions to vegetation control such as *Watercourse Re-vegetation, Factsheet #20*.

Mowing Bank Vegetation BMPs (Grass and Blackberry)

1. Fall and winter are the preferred times of year for mowing vegetation along watercourses. Mowing during fall/winter months allows for riparian vegetation to green up along the ditch during the summer months and provide shade to help keep water temperatures cool. Vegetation along the banks of a watercourse also provides protective cover for juvenile fish and shades out instream vegetation.
2. Dry watercourses or watercourses where the streambanks would be too wet and unstable in the fall can be mowed at any time.

Mowing Watercourse Vegetation BMPs

1. Timing Limitations: When water is present mowing shall take place in the low flow period of August 1 to September 30.
2. Mowing equipment can only cut and remove vegetation from the channel and shall not alter the channel profile or the slope of the channel banks.
3. Large woody material embedded in the bank or streambed shall be left undisturbed and intact.

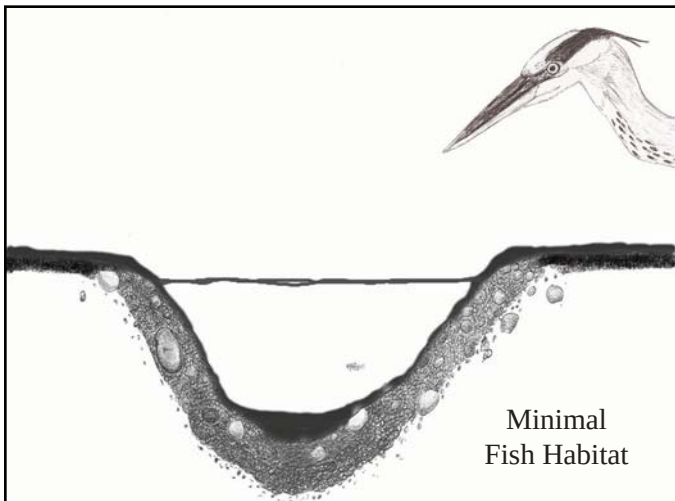
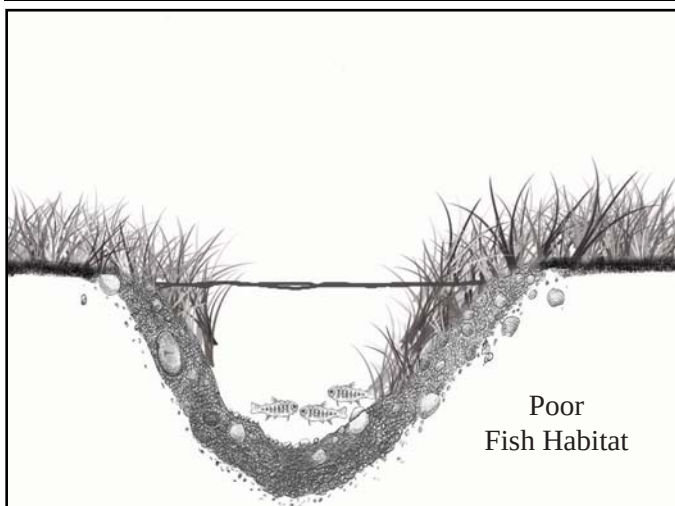
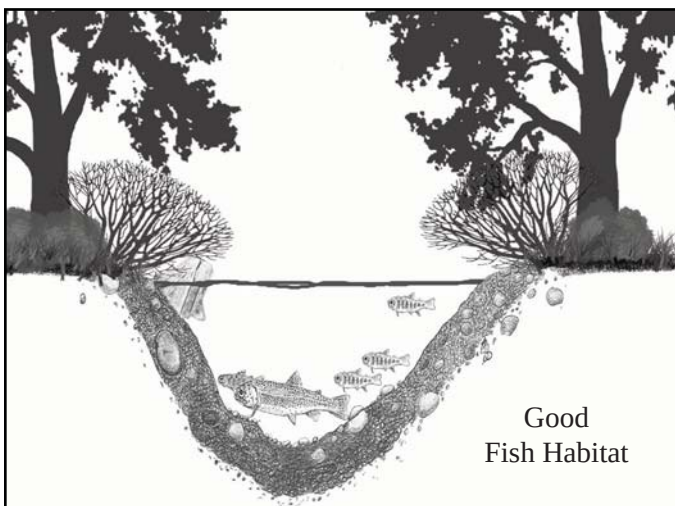
Vegetation Management (Trees & Shrubs)

Native trees and shrubs provide critical functions along all types of watercourses. They provide food for fish and other aquatic animals, filter sediment and other pollutants, and shade the watercourse, keeping temperatures low and reducing vegetation in the water. Roots from native woody plants create a dense mat, preventing erosion and bank failure.



Tree & Shrub Management BMPs

1. Leave native trees and shrubs intact unless it is absolutely necessary to access the channel.
2. Prune vegetation by hand if possible and only on one side of the channel (north or east).
3. Vegetation on the south and west sides should be left to provide shading for the watercourse.
4. Prune vegetation in the fall or winter months so that vegetation shades the water during summer to help keep water temperatures cool.
5. All fallen debris from hand-cutting or pruning should be cleared from the watercourse to prevent flow blockages and to prevent decaying material from reducing oxygen levels in the water and harming fish.
6. The vegetation pruning area should only be wide enough to allow equipment access to conduct maintenance. Vegetation removal should be minimized as much as possible.
7. Maintain the integrity of the ditch by keeping the vegetation roots in place and bottom and bank side slopes intact.
8. If maintenance activities inadvertently damage native vegetation, the native vegetation should be replanted. See *Factsheet #20 Watercourse Re-vegetation* for helpful guidelines.



Drainage Management



BMP Factsheet #10

AQUATIC HERBICIDES and WATERCOURSE MAINTENANCE

Introduction

Aquatic herbicide applications are an effective means of maintaining drainage in watercourses where Reed canarygrass infestation traps sediment and impedes flow. However, the use of herbicides in and around water also has potential negative impacts to water quality and to fish habitat and is strictly regulated by the Washington State Department of Ecology (WDOE) and the Environmental Protection Agency (EPA).

Do I need permits?

- A National Pollutant Discharge Elimination System (NPDES) permit must be obtained before aquatic herbicides can be applied to water.
- Applicators must be licensed by the Washington State Department of Agriculture.
- Notification and posting are required before herbicide application and there may be additional mitigation proposed to protect rare plants or threatened and endangered species.

The general permit covers the discharge of products used to control noxious weeds in waters of Washington State. Under the Washington State Water Pollution Control Act, a permit is required to discharge pollutants that alter the biological or chemical characteristics of a water body.

How: Permit coverage can be applied for on-line at: http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/noxious/noxious_index.html.

Who: Drainage Improvement Districts, individual landowners, or the licensed applicator can act as the applicant and hold the permit.

What weeds: This permit applies only to plants on Washington State's noxious weeds list such as Purple loosestrife or Reed canarygrass. It is a violation of the permit to treat any native aquatic plants.

Note: Additional Federal requirements are needed for work on Lummi Indian Reservation lands.

What are the Advantages?

- Aquatic herbicides can be less expensive than other aquatic plant control methods, especially when used to control wide-spread infestations of state-listed noxious aquatic weeds.
- Occasional use will extend channel maintenance intervals.
- Aquatic herbicides are very effective if used in combination with long term practices such as *Watercourse Re-vegetation* (see *Informational Factsheet #20*) to shade out noxious weeds.

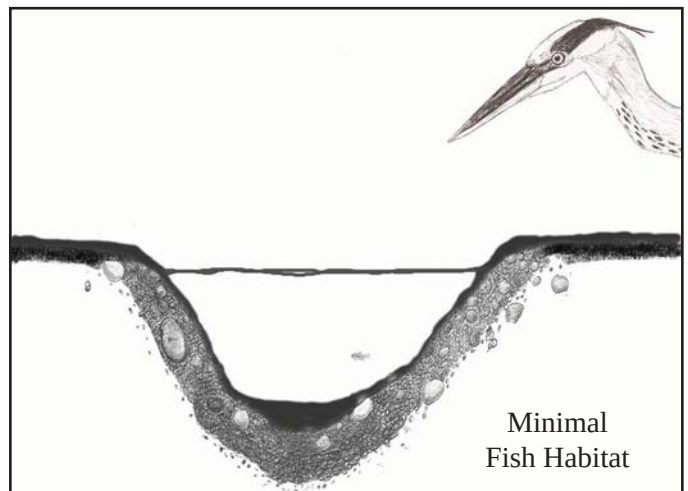
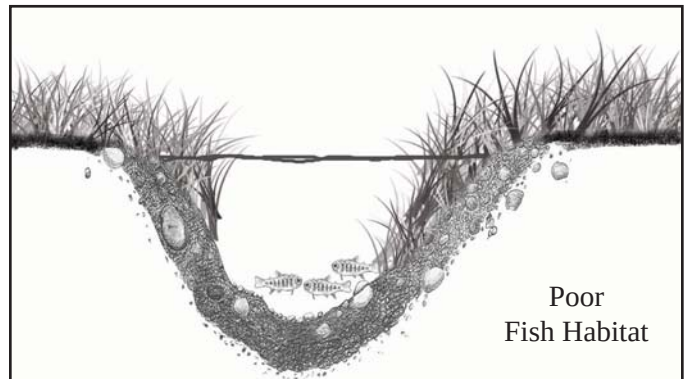
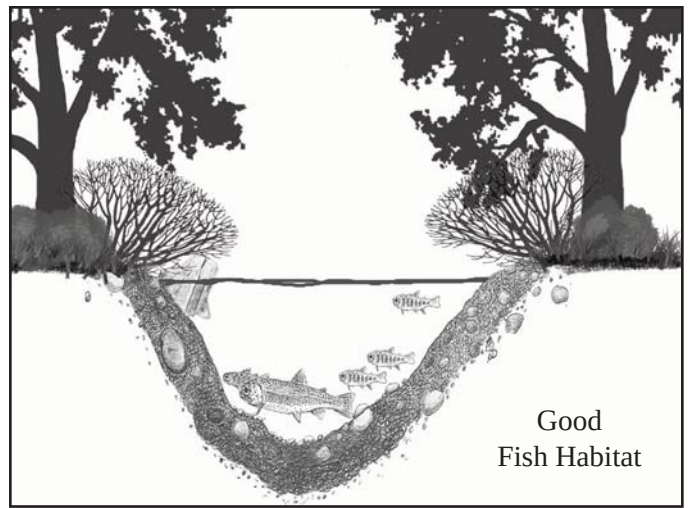


Aquatic herbicide on Reed canarygrass

What are the Disadvantages?

- Herbicides applied to vegetation on watercourse banks may kill the plant roots stabilizing the bank, resulting in erosion, bank failure, and additional dredging expense to clear the channel.
- Herbicides may have restrictions relative to swimming, drinking, fishing, irrigation, and water use. Check the label and general permit for restrictions.
- Herbicide use may have unwanted impacts to people who use the water and to the environment.
- In addition to nuisance plants, non-targeted plants may be negatively affected or killed by some herbicides.
- Depending on the herbicide used, it may take several days to weeks or several treatments during a growing season before the herbicide controls or kills treated plants.

- As treated plants die and decompose in the water, low oxygen conditions will develop that can kill fish, insects and other aquatic life.
- Some expertise in using herbicides is necessary in order to be successful and to avoid unwanted impacts.
- Many people have strong feelings against using chemicals in water. Find out what your neighbors think about chemical use before deciding to treat your water plants with herbicides.
- Some cities or counties may have policies forbidding or discouraging the use of aquatic herbicides. Check before hiring an aquatic herbicide applicator.



Bank Failure following herbicide application

Aquatic Herbicide BMPs

- Use only when permits have been secured.
- Use only licensed applicators.
- Limit applications to vegetation in the channel bottom.
- Do not apply to stream bank vegetation or bank stability will be lost.
- Apply in late summer and early fall for best results.
- Spring and early summer applications rarely result in a lethal dose but may be effective in reducing growth rates and maintaining drainage throughout the summer.



Reed canarygrass controlled using shade

Is this a long term solution?

Aquatic herbicides can be one useful component of a drainage maintenance plan for a Drainage Improvement District or landowner. However their use is limited. For example, if field sediments are eroding into the watercourse, farm practices such as replacing bare ground with vegetative filter strips will save costs and soil over the long term. Reed canarygrass provides some cover and habitat for fish. Repeated annual herbicide treatments will eliminate this habitat unless it is replaced with another vegetative cover. (See *Informational Factsheet #20 Watercourse Re-vegetation*).

CULVERT MAINTENANCE & REPLACEMENT

Introduction

Road crossing culverts are common on all types of watercourses and are critical infrastructure for field and farm access. But if undersized or poorly installed, culverts can be a problem because they impede or block fish passage to important habitat. Culverts that impede fish passage have been identified as one of the most limiting factors to healthy stocks of migrating salmon and other fish species. In comparison, well constructed bridges are superior to culverts in allowing drainage and fish passage. Consider replacing culverts with bridges (see *BMP Factsheet #12 Bridge Maintenance and Replacement*).

Drainage Improvement Districts (DIDs) may include and permit culvert maintenance and replacement as part of their Drainage Maintenance Plan (DMP) if Best Management Practices (BMPs) listed in this *Factsheet* are adopted.

Culvert Replacement and Fish Passage

When replacing or installing a culvert in natural watercourses or modified natural watercourses, the design will largely be based on criteria necessary to ensure fish passage and avoid impacts to fish habitat. There are five common conditions at culverts that create barriers to migrating fish:

- Excess drop at the culvert outlet

- High velocity within the culvert
- Inadequate depth within the culvert
- Turbulence within the culvert
- Debris and sediment accumulation at the culvert inlet or internally

The Washington Department of Fish & Wildlife (WDFW) has published extensive information on culvert design and installation. This guidance should be used when replacing an existing culvert or installing a new culvert. It is recommended that installations on constructed watercourses also use WDFW criteria because it ensures that new culverts are properly sized and will not impede drainage. See *Factsheet #4 Agency Contact Requirements*. Additional fish passage criteria can be found at http://www.nwr.noaa.gov/Salmon-Hydropower/FERC/upload/fish_passage_design.pdf.

Culvert Maintenance BMPs

Every watercourse structure will require periodic maintenance. Culverts often become plugged or their capacity reduced because of debris or vegetative material. Headwalls may need occasional maintenance to prevent erosion and collapse. In conducting maintenance activities consider:

1. Timing Limitations: When water is present, culvert maintenance shall only occur from August 1 to September 30 when flows are low.
2. Debris or vegetative material can be removed by hand without timing limitations to prevent the need for larger repairs.
3. Maintenance work on culverts in modified natural watercourses are subject to *Agency Contact Requirements*, see *Permitting Factsheet #4*.
4. Headwall repair should take place during the dry season when the work can be completed out of the water.
5. If water is present when removing large quantities of debris, vegetation or accumulated sediments, additional measures must be taken to minimize impacts to aquatic life and water quality. See *BMP Factsheet #16 Water Quality Protection Measures* for more details.



Salmon jumping at culvert.

Culvert Replacement or Installation

Three design options have been approved by WDFW:

- The No-Slope Design Option results in reasonably sized culverts without requiring much in the way of calculations. The No-Slope option is almost always the best choice for lowland agricultural watercourses.
- The Hydraulic Design Option is based on velocity, depth and maximum turbulence requirements for a target fish species and age class.
- The Stream Simulation Design Option involves constructing an artificial stream channel inside the culvert, thereby providing passage for any fish that may be migrating through the reach.



Undersized culvert with unstable road crossing

Culvert Location

Even the best designed culvert has the potential to become a fish passage barrier, drainage barrier or maintenance headache. Look at your farm or Drainage Improvement District from a big-picture perspective and find ways to have as few culverts as possible. Location considerations include:

- Make the culvert as short as possible without deviating from the direction of the upstream and downstream channel course by more than 30 degrees.
- Choose an area with minimal and consistent stream gradient, not areas where the gradient is steep or transitioning.

No-Slope Design Option

Successful fish passage can be expected if the culvert is sufficiently large and is installed flat, allowing the natural movement of bedload to form a stable bed inside the culvert. Bedload is the sediments making up the watercourse bottom such as gravel and soils. Design criteria for a No-Slope culvert are:

- Width equal to or greater than the average channel bed width at the elevation the culvert meets the streambed. Make the culvert the same width as the channel to maximize both water flow and fish passage.
- A flat gradient. (No slope)
- The downstream invert is countersunk below the channel bed by a minimum of 20 percent of the culvert diameter or rise.
- The upstream invert is countersunk below the channel bed by a maximum of 40 percent of the culvert diameter or rise.
- The possibility of upstream headcut has been taken into account.
- There is adequate flood capacity.

Combining the requirements of countersinking the outlet and the culvert width for a circular culvert, the diameter must be at least 1.25 times the channel bed width. The information typically needed for a No-Slope Design Option culvert includes:

- The average natural channel-bed width.
- The natural channel slope.
- The elevation of the natural channel bed at the culvert outlet.
- The evaluation of potential headcut impacts upstream of the culvert.

Channel-bed Width

Use the average of at least three typical widths in free flowing and unconstrained areas upstream and downstream of the culvert location. For the purpose of culvert design, the channel-bed width is defined as the width of the bankfull channel. The bankfull channel is defined as the stage when water just begins to overflow into the active floodplain. Many incised streams or modified watercourses are no longer connected to the floodplain. In these situations the channel bed width may also be determined from the Active Channel Width and Ordinary High Water Mark (OHWM). The OHWM can usually be identified by physical scarring along the bank



Culvert Replacement

or shore, or by other distinctive signs such as the lower line of perennial vegetation. This scarring is the mark along the bank where the action of water is so common as to leave a natural line impressed on the bank. That line may be indicated by erosion, shelving, change in soil characteristics, destruction of terrestrial vegetation, presence of litter or debris, or other distinctive physical characteristics.



Culvert Replacement

Channel Slope

The calculation for average channel slope is based on water-surface elevations and a distance along the channel that is at least 40 channel widths long, or 400 feet.

Once these determinations are made, a culvert design can be finalized. In fish bearing watercourses it has become common place to fill the bottom 20% of the culvert with “fish gravel” to both stabilize the bed material and enhance a little fish habitat. It may be advisable to hire professional help to ensure an appropriate design and long lasting installation.

Concrete

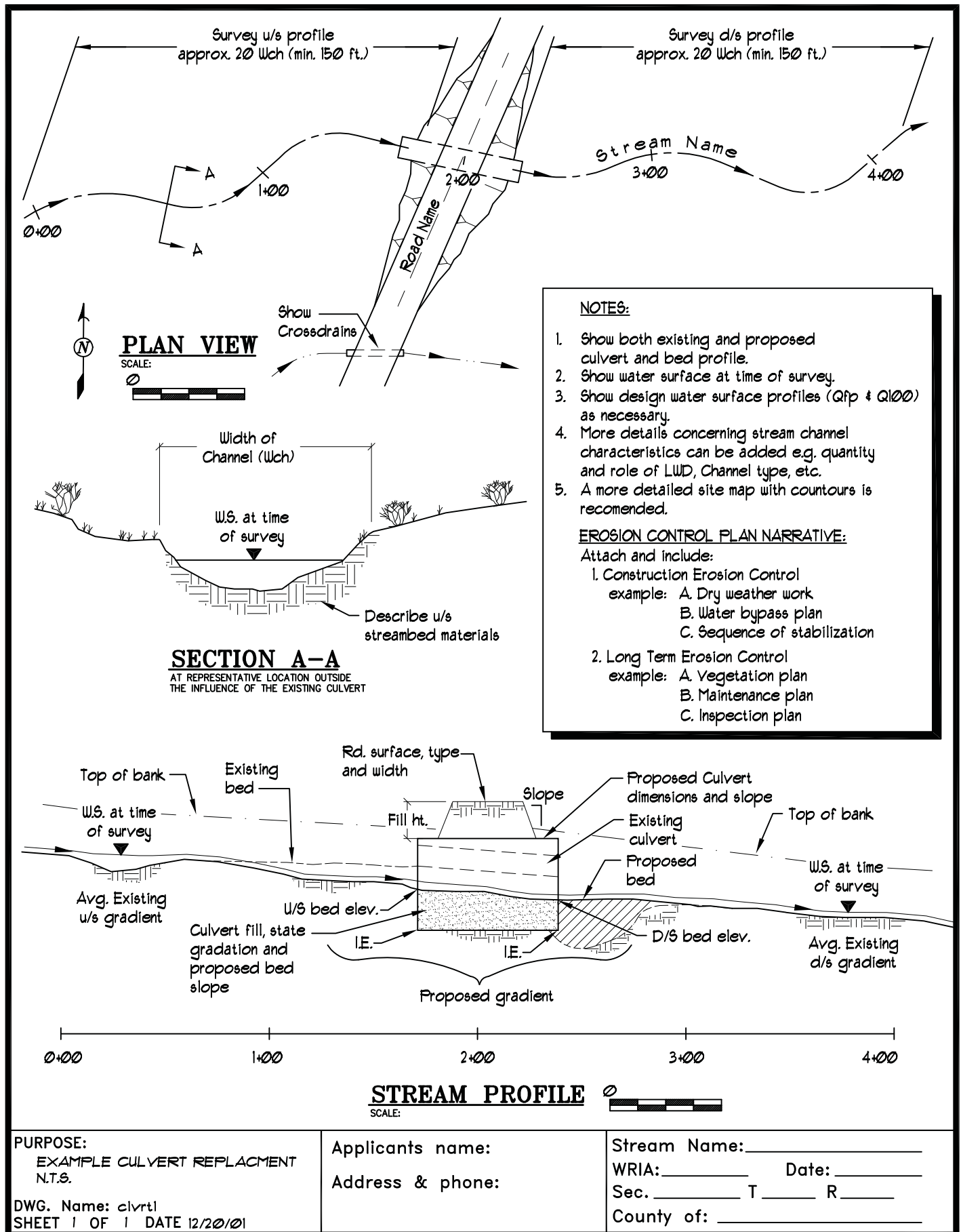
If any concrete, cast-in-place concrete, or grouting works are to be undertaken, a high potential exists for concrete and/or concrete leachate to enter a watercourse. Concrete, concrete leachate, grout and other uncured concrete substances (e.g. concrete bags for headwall construction) are deleterious and highly toxic to fish and other aquatic organisms.

To perform any concrete-related works, all water must be completely isolated prior to the commencement of any instream works. In addition, measures must be taken to prevent the incidence of concrete from entering a watercourse, ravine or storm sewer system for a minimum of 72 hours after the works have been completed. This is to ensure that the concrete has fully cured.

Culvert Replacement BMPs

1. Timing Limitations: When water is present in the channel, culvert work below the waterline shall occur between August 1 and September 30.
2. The damaged culvert and associated fill shall be removed from the watercourse and deposited upland so that it cannot re-enter the watercourse.
3. The culvert shall be placed on a flat gradient with the bottom of the culvert placed below the level of the streambed a minimum of 20 percent of the culvert diameter for a round culvert, and 20 percent of the culvert’s rise for an elliptical culvert. The 20 percent placement below the streambed shall be measured at the culvert outlet. (see above for more details).
4. The culvert shall be constructed to pass the 100-year peak flow with consideration of the debris likely to be encountered.
5. The culvert shall be maintained free of debris to ensure unimpeded drainage and fish passage.
6. Fill associated with the culvert installation and approach material shall be structurally stable and shall be composed of material that, if eroded into the watercourse, shall not be detrimental to fish life.
7. Fill associated with the culvert installation and approach material shall be protected from erosion to the 100-year peak flow.
8. If an existing culvert is replaced by a bridge structure, then the existing culvert and associated fill shall be completely removed from the watercourse and the new bridge shall be subject to the bridge provisions discussed in *Factsheet #12 Bridge Maintenance and Replacement*.
9. When water is present in the channel, fish must be removed from the impacted area prior to any work. *Factsheet #15 Fish Protection* provides more detailed information.
10. When water is present in the channel, measures must be implemented to ensure that contaminated water does not leave the work site. *Factsheet #16 Water Quality Protection Measures* provides more detailed information.
11. Leave riparian vegetation along the banks of the watercourse.
12. All disturbed areas must be re-graded and stabilized by seeding or re-vegetating the riparian area upon completion. This helps to prevent surface erosion and/or sedimentation of the watercourse.

Figure 1



Drainage Management



BMP Factsheet #12

BRIDGE MAINTENANCE AND REPLACEMENT

Introduction

In fish bearing waters, bridges are preferred as water crossing structures in order to ensure free and unimpeded fish passage and to preserve spawning and rearing habitat. Other structures which may be approved, in descending order of preference, include: temporary culverts, bottomless arch culverts, arch culverts, and round culverts. Professional engineering assistance should be used for bridges over natural watercourses and modified natural watercourses. Multiple landowners should consider constructing a single shared bridge rather than individual crossings.



Livestock crossing made of recycled concrete bridge panels

Approval Requirements

Maintaining or replacing bridge structures requires Hydraulic Project Approval (HPA) from the Washington State Department of Fish & Wildlife (WDFW) with review by Whatcom County Critical Areas and Flood Division. Drainage Improvement Districts (DIDs) can permit, maintain and replace bridges on modified watercourses using their Drainage Management Plan (DMP) and using the Best Management Practices (BMPs) listed below.

Work on bridges over Constructed watercourses requires only Whatcom County Planning and Development Services notification if located within a critical area. The written notification must be sent to the Technical Administrator at least 10 business days prior to beginning and should include:

- Bridge design drawings and specifications.
- Type of equipment to be used.
- Manner in which the equipment will be used.
- Best Management Practices to be used.

Bridge construction may also require a permit from the Army Corps of Engineers.

Bridge Replacement BMPs

1. Timing Limitations: When water is present in the channel, the bridge work below the waterline shall occur only from August 1 through September 30 of any year for the protection of migrating juvenile and adult salmon.
2. Damaged bridge elements shall be removed from within the banks of the watercourse and deposited upland so that they cannot re-enter the watercourse.
3. New bridge footings or foundations shall be constructed landward of the channel high waterline at the project site.
4. Excavation for the bridge footings or foundations shall only occur landward of the high waterline of the watercourse.
5. The bridge shall be constructed to pass the 100-year peak flow with consideration for debris likely to be encountered.
6. Fill associated with the bridge or water crossing structure installation shall be protected from erosion to the 100-year peak flow.
7. Armoring of the channel banks to protect the bridge footings or foundations with rock materials shall be limited to the bank area immediately under the footprint of the bridge.
8. Approach material for the bridge shall be structurally stable and be composed of material that, if eroded into the watercourse, shall not be detrimental to fish life.
9. Alteration or disturbance of bank vegetation must be limited to that necessary to construct the project.

Bridge Maintenance BMPs

1. Vegetative and other debris should be removed by hand (if possible) at any time before it builds up and threatens the structure.
2. Measures shall be implemented to ensure that any waste materials from sandblasting and painting do not enter the watercourse.
3. Limit pruning of native trees and shrubs to the minimum needed to provide bridge access.

Livestock crossing made of retired rail flatcar





SEDIMENT TRAPS

Introduction

A sediment trap is generally an easily accessible constructed 'basin' or depression on a watercourse where sediment settles out and accumulates, allowing for its removal. Sediment trap maintenance (removal of accumulated sediment) is necessary to ensure proper function. A well-functioning sediment trap enables you to trap and remove sediments regularly from one location rather than having to maintain an entire watercourse reach, saving money and reducing negative impacts to aquatic life and water quality.

Prior to installing a new sediment trap, investigate other means to control sediment input into surface waters, such as installing riparian buffers and grass filter strips. Sediment traps should not be located in areas with gravel or cobble spawning substrates and should be located downstream far enough to preclude upstream head-cut of spawning areas. Log weirs can be installed to reduce the potential of head-cuts, but need to ensure fish passage. The streambank next to the sediment trap should be planted with native trees and shrubs, leaving a small area to provide access.

Impacts

Sediment traps are not naturally occurring features of a watercourse. Sediment traps can have both benefits and drawbacks to fish and other aquatic life.

Benefits:

- Fish may benefit from deep pools creating refuge below the water column in constructed or modified watercourses.
- Downstream habitat may be improved as a result of smaller quantities of fine sediment accumulations below the sediment trap.

Drawbacks:

- Downstream habitat may be degraded and lose complexity if coarse sediments (gravel, wood) are trapped.
- In seasonal watercourses fish may become stranded in the sediment trap

rather than moving downstream as flows decrease.

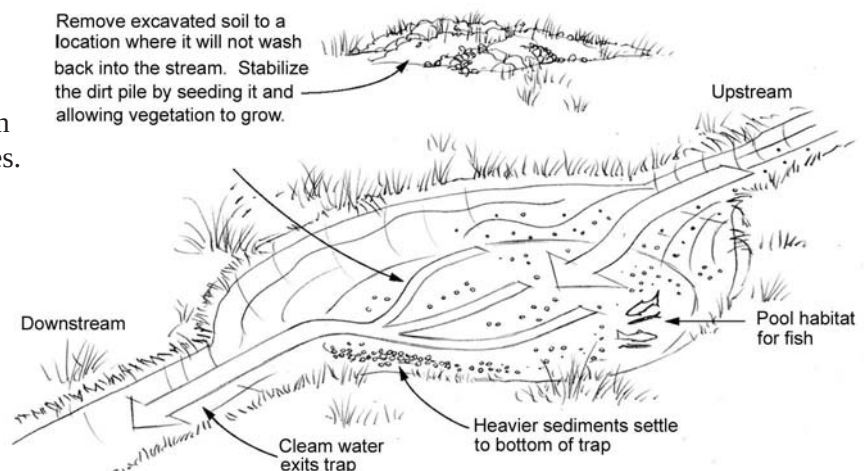
- Large or regularly maintained sediment traps may not be shaded well enough to keep water temperatures low enough to support aquatic life.
- Upstream head cutting may be a problem if sufficient gradient exists. The result can be channel destabilization and increased erosion upstream.
- Flow control structures may be needed at either end of the sediment trap. These structures will impede the natural flow of water and may impact fish passage.

Permitting

Constructing a new sediment trap requires individual permitting and is not included in a Drainage Improvement District's (DID) Drainage Management Plan (DMP). Maintaining existing sediment traps within DIDs can be permitted as a component of the DMP if the Best Management Practices (BMPs) listed below are followed.

Locating a Sediment Trap

- Locate a sediment trap where accumulations of sediment consistently occur, such as the point where two constructed ditches meet or at a significant break in slope where water velocity slows and sediment accumulates as it drops out of the water column.



SEDIMENT TRAP IS TWO TIMES AS LONG AS IT IS WIDE

- An easily accessible location such as a road crossing may also be appropriate if riparian vegetation exists or is planned, *Factsheet #20 Watercourse Re-vegetation*.

Constructing a Sediment Trap

- The size of a sediment trap depends on the velocity of the water entering the trap and the size of particles that are to be filtered out. Heavier sediments such as gravel and sand settle out faster than fine sediments such as silt or clay. Qualified professionals should be consulted.
- In lowland agricultural areas small traps may be simply constructed by widening and deepening a portion of the constructed ditch.
- Generally, the effective length of the sediment trap should be at least twice the width of the basin. To ensure slope stability the bank side slopes should be 2 horizontal to 1 vertical or flatter with a maximum height of 10ft.
- A combination of sluice gates or flashboard risers and bypass channel or bypass pipe may be useful to facilitate maintenance.

Maintaining Sediment Traps

- Accumulated sediments should be removed periodically, every 1 to 10 years depending upon sediment load.
- Clean the trap when it's half full. Do not allow sediments to build up, overflow the trap and accumulate downstream.
- Clean sediments in the late summer or early fall when the water is the lowest. If the watercourse is dry you can maintain the trap at any time, see *Factsheet #1 Hydraulic Project Approval*.

Best Management Practices for Sediment Trap Maintenance

1. Work must be completed during the time period of August 1 to September 30 when water levels are low.
2. Fish must be removed prior to maintenance work. Refer to *Factsheet #15 Fish Protection*.
3. All work must be conducted during favorable weather and low water conditions. If heavy rain occurs unexpectedly, delay maintenance until water levels recede.
4. Sediments or muddy water should not be released downstream. Monitor closely and implement Sediment Control BMPs when needed.
5. Leave riparian vegetation along the banks of the watercourse.
6. Excavation should be limited to the design profile. Deepening the trap may cause bank failure and erosion.
7. Equipment used to complete drainage maintenance activities shall only operate from the top of the channel bank and not from within the watercourse.
8. All equipment used must be in good repair and be free of excess oil and grease. All hydraulic equipment used in the watercourse must use environmentally sensitive hydraulic fluids.
9. A spill containment kit must be readily accessible on site in the event of a spill. Any spills of deleterious substance into a watercourse must be immediately reported to WDOE.
10. Refueling of equipment should be conducted a minimum of 50' away from any watercourse.
11. Dredged materials must be placed landward in such a way that its re-entry into the watercourse is prevented. It may be added to adjacent fields or hauled off site.

Note: The most cost effective drainage maintenance BMP is to identify the source of sediments and prevent them from entering the watercourse. See *Informational Factsheet #22 Farm Practices*.

CONSTRUCTED WATERCOURSE MAINTENANCE

Introduction

Drainage Improvement Districts (DIDs) can maintain constructed ditches without a Hydraulic Project Approval permit from the Washington Department of Fish and Wildlife. Nor is a permit from the Department of Army Corps of Engineers needed if the watercourse is determined to be “non-navigable”. However Best Management Practices (BMPs) must be implemented to avoid polluting downstream natural or modified watercourses. Informational *Factsheet #18 Watercourse Classifications* defines “constructed” and a DID’s map should have all watercourses color coded by classification.

Critical Areas include: Wetlands, Frequently Flooded Areas, Critical Aquifer Recharge Areas, Geologically Hazardous Areas, or Habitat Conservation Areas.

Constructed watercourses in active agricultural land are generally not critical areas.

Constructed Watercourse Maintenance BMPs

General:

1. Only remove material sufficient to keep the original ditch depth or to maintain a steady slope between culvert inverts. Excavating deeper will not improve drainage and may result in unstable banks and erosion.
2. Place excavated material in a location so that it cannot re-enter the watercourse.
3. Equipment used to complete drainage maintenance activities shall only operate from the top of the channel bank.
4. All equipment used on the site must be in good repair and be free of excess oil and grease.

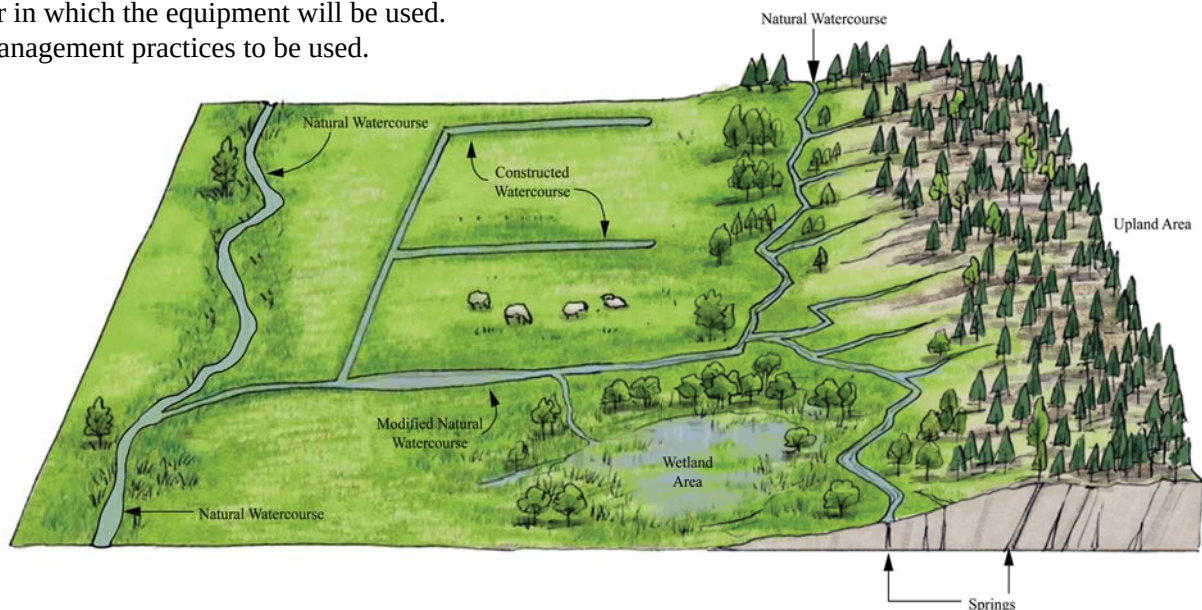
If the watercourse is Dry:

5. Work can be done at any time.
6. Maintain the channel early enough in the year that vegetation may stabilize soils prior to the rainy season.

Local Regulations

Whether wet or dry, if the constructed watercourse lies within a Whatcom County designated “Critical Area” or a “Critical Area Buffer”, a notification must be sent to the Whatcom County Technical Administrator at least 10 business days prior to beginning work. The written notification is valid for up to five years and should include:

- Type, timing, frequency and sequence of maintenance activity to be conducted.
- Type of equipment to be used (hand or mechanical).
- Manner in which the equipment will be used.
- Best management practices to be used.





Recently maintained constructed ditch

7. Install temporary Check Dams, Triangular Silt Dams, Silt Fence, Straw Wattles or other measures to prevent exposed sediments from moving once the rainy season has begun.
8. Maintain a 25 foot to 300 foot grass lined swale at the downstream end of the watercourse to filter out any released sediments when water flows.

If the watercourse is Wet:

9. Conduct maintenance activities during periods of lowest flow (August 1 to October 30th).
10. Dredge from upstream to downstream to allow vegetation in the channel to help filter and trap sediment.
11. Install a silt curtain or other means to block or filter the muddy water flowing downstream.
12. If fish in distress are observed, cease work and use Fish Protection techniques from *Factsheet #15* in this series. Also contact your WDFW Area Habitat Biologist for assistance (see *Agency and Organization Contacts, Factsheet #5*).
13. Monitor closely for muddy water leaving the constructed watercourse. Muddy, sediment-laden water must not be allowed to enter natural or modified natural receiving waters downstream. **Before** this occurs, consider the following tips and refer to *Factsheet #16 Water Quality Protection Measures* for more guidance.
14. Pause the maintenance work frequently and allow suspended sediments to settle out.
15. Install temporary coffer dams, additional silt screens, bypass pumps, or other means to reduce the impact.
16. Remember, it is OK and expected that water in the constructed ditch you are maintaining will be muddy. But it's not OK for that muddy water to be allowed to flow downstream and adversely impact other watercourses.



Grass strip left intact temporarily to filter sediments

Cleaning Subsurface Drain Tiles

Subsurface drain tiles may need to be maintained or flushed periodically due to the buildup of sediment or iron ochre.

To minimize impacts on the watercourses downstream when cleaning drain tiles consider the following:

- Install a control structure (or block the ditch downstream) to prevent sediment and iron ochre from moving into the receiving waters of a natural or modified watercourse.
- Install a sediment trap at the downstream end of the ditch to collect contaminated water. Pump the collected water into an area where it will not re-enter the ditch. Clean the sediment trap prior to opening the control structure and allowing flow to proceed downstream.
- More useful BMPs can be found in *Factsheet #16, Water Quality Protection Measures*.



Muddy water from a constructed ditch flowing into a fish-bearing stream

FISH PROTECTION

Introduction

It doesn't matter to fish whether a watercourse is labeled as natural, modified natural, or constructed. Fish will make use of the watercourse at some life stage if there is water of sufficient quality and quantity and if there are no obstructions to access. Maintenance of any watercourse presents the potential to harm fish or fish habitat. This fact sheet will help you determine when and how to conduct fish removal so as to minimize harming fish and avoid incurring civil and criminal penalties.

Projects where fish removal is necessary will likely require a Hydraulic Project Approval (HPA) from the Washington State Department of Fish and Wildlife (WDFW). See *Factsheet #1 Hydraulic Project Approval* for more information on the permitting process. The HPA will have detailed directions for fish removal activities. Guidelines in this Factsheet are general approaches to fish removal methods, the HPA will serve as the primary protocol for fish removal.

What is fish Removal?

A fish removal involves collecting fish from an isolated watercourse reach where maintenance work is being done and relocating the fish upstream or downstream of this section.



A constructed ditch can provide valuable habitat for fish

When do I conduct Fish Removal?

Modified Watercourses

Fish must be removed from the watercourse prior to any in-water maintenance activity. It is understood that fish removal may not be entirely effective when there is a dense Reed canary grass infestation.

Constructed Watercourses

Fish are assumed to not be present in constructed watercourses. However, if fish are observed in distress during in-water maintenance activities then fish removal BMPs should be implemented.

Fish Removal BMPs

1. Qualified staff must be on site at all times during drainage maintenance work.
2. Isolate the work area by placing a **block net** at the top and bottom end of the section planned for maintenance.
3. Select a fish collection method or methods (see below) best suited to the watercourse.
4. Repeat this method or sequence of methods three times to make sure all the fish have been captured from the isolated section.
5. Monitor the work area, affected downstream area, and spoils closely for signs of fish in distress.
6. If fish are observed in distress, pause the work and capture fish using dip nets and buckets of fresh water.
7. Immediately relocate fish to an area of clean, free flowing water.
8. Continue to monitor and remove fish when needed.
9. Pausing work frequently to maintain relatively good water quality is the best method to ensure minimum impacts to any remaining fish.
10. Remove block nets when maintenance work is complete and water quality impacts have settled.



Fish rescued from work area must be relocated to a upstream or downstream site

Fish Removal Techniques:

Seine net: a net with weights along the bottom and floats at the top to enable the net to stand in water. Typically, seine nets with a small mesh size (1/8"–1/4") are adequate for trapping or moving young fish in small-sized channels. These types of nets are relatively small and easy to maneuver in smaller channels. One technique



Stream Seine Net

is to encircle and then remove schools of fish using dip nets. Another is to drag the net downstream, encouraging fish to move below the channel reach planned for maintenance. Both of these techniques can be made more effective by first removing some of the water by means of a coffer dam or water diversion, then seining and removing fish in the remaining pools.

Electrofishing: passes electric current through the water that attracts and stuns fish and is most effective in small streams and rivers. Electro-fishing is commonly done on foot using a backpack shocking device or from a boat with a boat-shocker. Special training and certification is required to electrofish. Electrofishing can be highly stressful to fish. Mortality can be extremely high in warm water conditions.



Electrofishing with a Backpack Shocking Device

A common practice is to use a lower risk method (i.e. seine netting and dip nets) for the first two passes and then use a more exhaustive approach (i.e. electrofishing) for the third and final pass. Once each pass is done, immediately relocate the removed fish into an upstream or downstream portion of the watercourse.



What Else Do I Need to Know?

If you do not have the expertise and equipment or time to perform your own fish removal, you can hire someone to do this for you. Fish removal work is specialized and it is recommended that a professional be hired.



Fish Biologist with dip net

It is the responsibility of both the Drainage Improvement District holding permits and the contractor performing work to ensure that all appropriate means have been utilized to avoid negative impacts to fish.

WATER QUALITY PROTECTION MEASURES

Introduction

It probably goes without saying that one cannot muck around in a wet ditch without stirring up the mud. Stirring up too much mud (sediment) without taking necessary protective measures or without obtaining a permit can land you in trouble with the agencies charged with protecting water quality. Too much sediment can cause significant harm to fish, fish habitat and other beneficial uses, and water quality standards have been set under Federal, State, and Tribal law to protect these values. This *Factsheet* provides guidance on how to conduct common watercourse maintenance activities without risking a stop work order or a fine when water quality impacts occur. Generally, any activity that impacts water quality will require a Hydraulic Project Approval permit from Washington State Department of Fish and Wildlife (WDFW). See *Permitting Factsheet #1 Hydraulic Project Approval* for more details.

Potential Impacts of Sediment Releases:

- Injury or death of fish. Sediment can clog or abrade fish gills, causing suffocation or tissue damage.
- Inability to feed. Since fish are visual feeders, sediment in water can impair their ability to forage for food.
- Infill habitat. Sediment may settle in pools or riffle habitats. This may impact salmonid egg viability or



Muddy water leaving a maintained watercourse

may affect food and nutrient sources by covering benthos (bottom-dwelling organisms) upon which fish depend for food.

- Clogging of irrigation intake screens and potential damage to downstream irrigated crops.

The Laws:

When undertaking any watercourse maintenance activity, controlling sediment and erosion is essential to ensure protection of fish and other aquatic species. The Federal Clean Water Act (CWA) Section 1251 & Washington State Water Pollution Control Act 90.48 (WPCA) prohibits the discharge of any pollutant from a point source into navigable waters or waters of the State. Tribal laws similarly prohibit pollutant discharges on the Lummi Indian Reservation. The Washington State Department of Ecology is charged with enforcing these laws for most of Whatcom County. The Federal Environmental Protection Agency (EPA) and the Lummi Natural Resources Department enforce these laws on the Lummi Indian Reservation. The CWA Section 404 and the River & Harbors Act of 1899 Section 10 require a Federal Permit before discharging dredged fill materials into the waters of the U.S. or before working on structures in or affecting navigable water. The Department of Army Corps of Engineers is charged with enforcing these laws. Knowing what water quality standards and permit requirements apply before engaging in any maintenance activities are the first steps to avoid liability.

Under all circumstances, maintenance activities must follow “All Known And Reasonable Technologies” (AKART) to avoid violating water quality standards for sediment releases, commonly referred to as “turbidity”. Where turbidity already exists in the “background, it need not be controlled or improved. However, maintenance activities must avoid increasing pollution beyond a specified amount. Prior to undertaking any work for Sediment Control, refer to the following factsheets in this series: *BMP Factsheet #15 Fish Protection* and *Permitting Factsheet #4 Agency Contact Requirements*.

Measuring Sediment Releases:

Sediment and erosion control measures should be in place both during and after works that have the potential to cause sedimentation of a watercourse. Suspended sediments are usually measured as “turbidity” and are measured as Nephelometric Turbidity Units or NTUs. Turbidity is the cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eye, similar to smoke in air.

Turbidity can be measured in a number of ways; the most common are:

- Turbidity meter – This tool measures the intensity of light scattered at 90 degrees as a beam of light passes through a water sample. A meter may be available from the Whatcom County Public Works River & Flood Division or the Whatcom Conservation District.
- Secchi disk – This inexpensive tool uses a black and white disk in the water to measure the relative clarity of water.
- Visual inspection – Significant sediment releases are easily visible to the naked eye.

Aquatic Life Turbidity Criteria – Applies to all natural and modified natural watercourses and constructed watercourse reaches within 300 feet of their confluence with a natural or modified natural watercourse.

- Salmonid Spawning, Rearing and Migration areas - 5 NTU over natural background levels when background is 50 NTU or less. If background levels are above 50 NTUs then the increase should not exceed 10% over background levels.
- Salmonid Rearing and Migration **Only** areas – 10 NTU over background when background is 50 NTU or less and a maximum 20% increase when the background turbidity is more than 50 NTU.



Turbidity Monitoring

Water Quality Guidance for Drainage Maintenance:

Helpful definitions and typical site plan:

Total Maintenance Dredging Work Zone – The watercourse reach scheduled for maintenance during the year’s work window including the Immediate Maintenance Dredging Work Zone and the Sediment Control Zone.

Immediate Maintenance Dredging Work Zone - The watercourse reach scheduled for maintenance during the year’s work window. The reach should be noted in a Drainage Improvement District’s Drainage Management Plan.

Sediment Control Zone – This area begins at the downstream edge of the Immediate Maintenance Dredging Work Zone and continues downstream for 200 feet. Typically one to three silt curtains are placed in this zone to capture and settle suspended sediments (see Best Management Practice (BMP) section below).

Point of Compliance – The point established at the downstream end of the Temporary Mixing Zone and identified on site with a stake or some other type of visible marker. This is the point where turbidity observations or measurements are taken to monitor compliance with Clean Water Act regulations.

Work Day – The length of watercourse planned for maintenance work in one day. The lowest section of a watercourse’s Immediate Maintenance Dredging Work Zone will be completed in the first day with additional

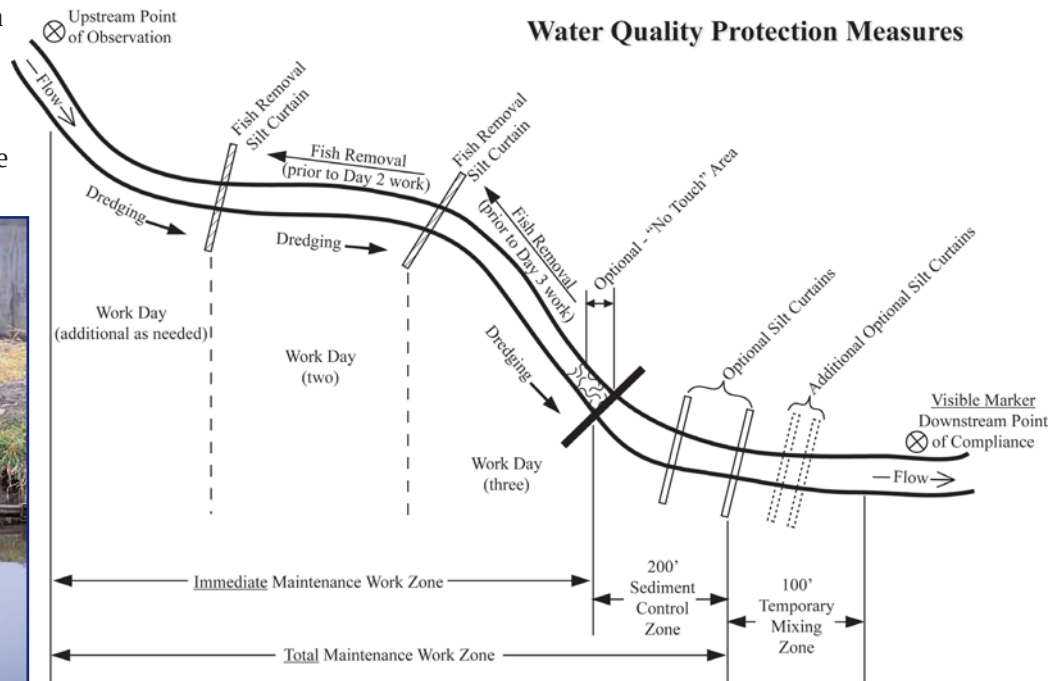


Figure 1

upstream reaches repeated until the planned work is complete.

Temporary Mixing Zone – When a channel maintenance project has received all permits and approvals and BMPs are being implemented to minimize the release of sediments, then a temporary mixing zone can be used to allow sediments to settle out of the water as follows:

- For waters up to 10 cubic feet per second (cfs) at the time of disturbance, the point of compliance shall be 100 feet downstream from the activity causing the turbidity exceedance.
- For waters above 10 cfs up to 100 cfs flow at the time of construction, the point of compliance shall be 200 feet downstream from the activity causing the turbidity exceedance.

Turbidity Best Management Practices (BMPs)

Diagram – A generic site diagram that generally illustrates watercourse maintenance dredging activities, application of BMPs and integrated fish removal procedures. See Figure #1.

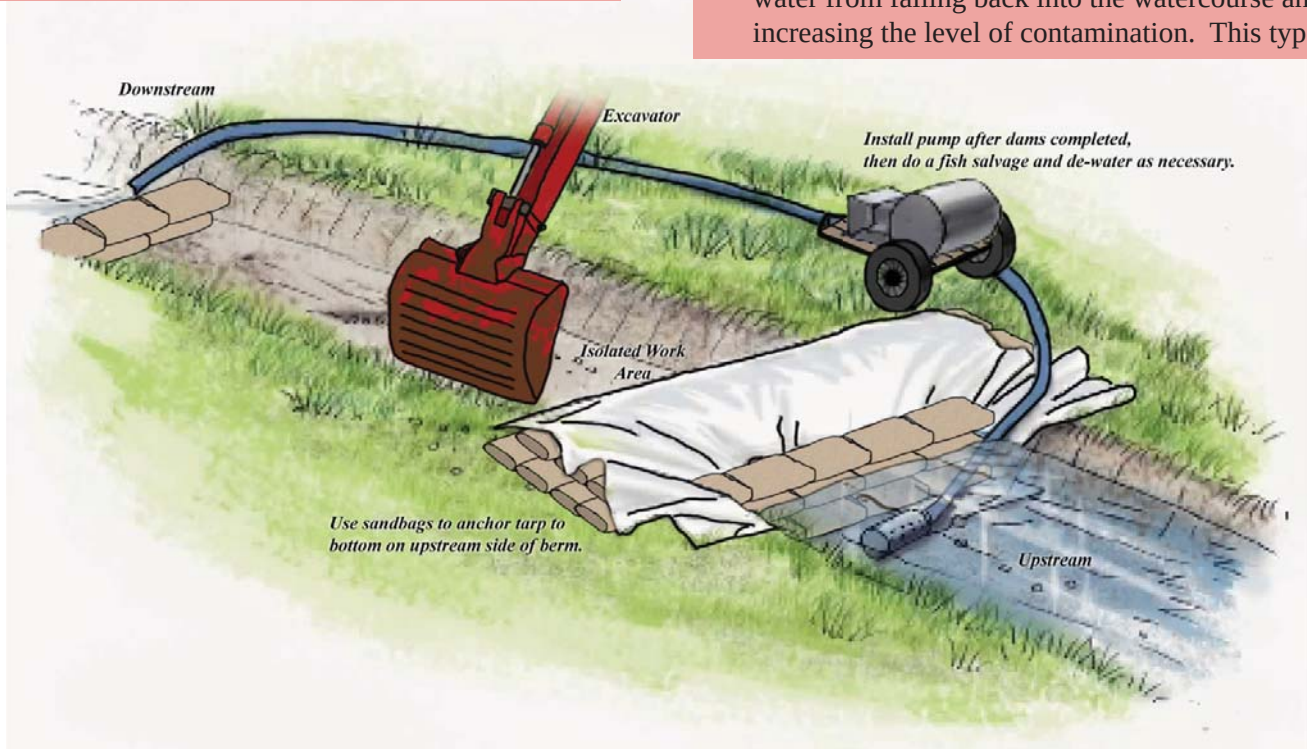
Sediment Control BMPs:

No single BMP or combination of BMPs will work under all conditions. Therefore, in approaching the problem of managing sediment, it is essential that you be vigilant in observing any impacts of your maintenance activities and adaptively apply different or additional BMPs in order to keep the discharge of pollution to less than what is allowed. Again, there is no single magic solution to control sediment release. Follow the process of:

1. Create an adaptive management strategy before work begins;
2. Start with simplest cost-effective strategies;
3. Closely monitor water quality to see if your maintenance activities are making conditions worse; and,
4. Implement additional BMPs until the impacts are within water quality standards.

The following BMPs will help control sediment release during channel maintenance activities.

- **Dry Season.** If at all possible, plan your maintenance work for the driest time of year, usually August – September. If there is less water flowing overall, it is less likely that dirty water will flow out of your worksite. Plan your crops to make sure the watercourse is accessible during the dry season.
- **Adverse Weather.** Suspend drainage work in adverse weather. Heavy summer rains can both increase flows beyond what you may be prepared for and may stir up sediments. Wait for low water levels to return prior to proceeding with maintenance work.
- **Spoils placement.** Place excavated materials well away from the watercourse to ensure they will not erode back into the watercourse.
- **Monitor closely.** Inspect the water downstream of your work site at the end of the appropriate mixing zone (usually 100 feet). Various tools are available to measure turbidity, however visual monitoring can be an effective measurement. A general rule is that if the water above your project looks clear then it needs to look as clear below your work area.
- **Lidded Bucket.** Use an excavator equipped with a clamshell or lidded bucket to prevent muddy water from falling back into the watercourse and increasing the level of contamination. This type



of equipment will probably be required in your Hydraulic Project Approval permit (HPA).

- **Work Direction.** Conduct maintenance activities from upstream to downstream to allow the downstream vegetation to screen and trap suspended sediments. Note: Impacts to fish may be less if work takes place downstream to upstream. Consult with the WDFW Area Habitat Biologist to determine the best site specific strategy.
- **Pause your work.** If you see muddy water in imminent danger of leaving your mixing zone, the easiest BMP is to stop, let the sediments filter out, then start again. After a little trial and error you should be able to set a sustainable work pace.
- **Channel Blocking.** Block the channel downstream to slow water flow and allow sediments to fall out. Multiple installations may be needed to capture all the sediment.
 - * **Fabric silt curtain.** Constructed of woven filter fabric with weights at the bottom and floats at the top.
 - * **Coffer Dam or Check Dam.** Rock, plywood, sandbags or other temporary structure to stop water flows and let sediments filter out.
- **Water Diversion*.** Pump some or all water around the work site and then return it to the channel. Isolating the work area and diverting flowing water around the worksite is the most effective method to ensure clean water law compliance. Pump intakes need to have fish screens meeting WDFW criteria to avoid entraining fish.
- **Water Removal.** Pump some or all the muddy water leaving the work area into an adjacent area for on site infiltration.
- **Coordination with Fish Removal Activities.** A silt curtain may be useful at the upstream end of the Work Day reach to isolate the reach after fish removal and to temporarily slow the flow of water through the reach.

*Deviation from this BMP may be allowed if WDFW or equivalent freshwater habitat biologist indicates pumping water around or from a channel maintenance project will create a more negative aquatic biological impact than the release of in-place sediments to downstream areas.



- Fabric Silt Curtain slowing flow and allowing sediments to settle
- passes through and to slow the water flow, allowing suspended sediments to drop out.
 - Install 1 – 3 curtains at 100 foot intervals beginning 100 feet below your work area.
 - Anchor the curtain sides with 8' to 10' heavy duty metal T posts as tightly to the edge of the watercourse as possible. The fabric curtain will naturally form to fill the channel profile.
 - Monitor curtains closely to ensure they are functioning. Your point of compliance for turbidity is usually 100' below the most downstream curtain.



Simple Coffer Dam slows the water flow allowing sediments to settle

Coffer Dam or Check Dam

Coffer dams are used to isolate a channel reach in order to complete maintenance work. For greater effectiveness, coffer dams may be combined with other methods such as clean water bypasses or pumps. Cofferdams can be made of a variety of materials (rock, sandbags, wood, etc). Considerations in their use include:

- Dam materials must be anchored into the banks of the ditch to prevent seepage and erosion around the edges of the dam.
- A common practice is to line the channel with a tarp

Additional Information on Instream BMPs:

Fabric Silt Curtain

Drainage Improvement Districts typically own their own silt curtains. They are made of woven fabric with tapered sides, weighted bottom and a float at the top. These inexpensive curtains are easy to install and can be moved as work progresses.

- Curtains 12' to 16' wide and 6' to 8' high can be utilized in most watercourses.
- Functions are to filter some muddy water as it

and then anchor it with a sandbag wall to ensure a tight installation.

- If there is water in the channel but little or no flow, temporary coffer dams may be the most cost effective means to isolate the channel and confine muddy water. Once sediments settle out, remove coffer dams slowly to prevent the release of sediments downstream.
- If there is significant water flow, a coffer dam upstream can temporarily block this flow or create a source for clean water diversion.
- A downstream coffer dam will help prevent muddy water from leaving the work area, prevent clean water downstream from flowing back into the work area and becoming contaminated, and can be used in combination with a muddy water removal pump.
- Monitor frequently. Extra material (for example, more sandbags) should be kept on site to raise the dam if water behind the dam threatens to spill over into the work area or if muddy water threatens to overflow out of the work area. Immediately repair any scour, gaps, or holes around the dam to prevent failure.
- Completely remove the dam once the maintenance work is complete.

Water Diversion

A water diversion redirects the water flow temporarily around the section of the watercourse where work is being conducted. Clean water is moved around the worksite to prevent contamination and then returned to the watercourse below the work area. Pumps are most commonly used however; in some cases an alternative channel or bypass flume may be used to transport some water or all water around the work site and then return it to the channel. Considerations in the use of water diversions include:

- The pumped diversion is suitable for intermittent and low flow streams that can be pumped. Pump capacity must be sufficient to handle the flow.



Minimal flow in work area after water is pumped around site



Diverted water returned to watercourse downstream

- Downstream sediment transport can almost be eliminated.
- Temporary coffer dams are constructed upstream and downstream of the work area.
- A pump intake screen meeting WDFW standards should be installed to protect fish and other aquatic life.
- An energy dissipation device should be installed to prevent scouring where water is pumped back into the stream.
- As water in the worksite recedes, monitor closely for distressed or stranded fish. See *Factsheet #15 Fish Protection*.
- Although pumping water can be expensive, sediment removal is less expensive and easier in a dry channel where an operator can see and maintain grades.

Water Removal

Pump water out of the worksite or pump some or all muddy water from the lower end of worksite before it contaminates receiving waters downstream.

Considerations in the use of water removal include:

- If there is little or no flow and either no fish present or fish have been removed, the maintenance project site can be isolated using coffer dams. Remaining water can be pumped into an adjacent area for onsite infiltration.
- Another practice is to pump out muddy water trapped above a coffer dam or turbidity curtain before it flows downstream.
- An adjacent grass field is commonly used to receive and filter contaminated water.
- Nearby grass lined ditches may also work well to filter sediments out before water eventually returns to the channel.
- Do not pump water into adjacent natural wetlands.
- Do not pump all the water out of a channel leaving downstream aquatic life to die.
- Monitor closely to ensure that muddy water does not re-enter the channel. Be prepared to move the

outflow pipe often to prevent over saturation of fields.



Erosion control fabric installed after maintenance work

- **Mulch & Mats.** Spreading straw over exposed soils reduces the erosive energy of rainfall and is a quick and inexpensive means to control erosion. Erosion control fabrics made of fine mesh and either straw or coconut fibers work well on steeper or erosion prone slopes.
- **Silt Fencing.** If excavated sediments are susceptible to erosion, install a silt fence below the sediments to prevent erosion. Silt fence should be trenched into the existing soil 4" to 6" and staked every 6' to 10'.
- **Straw Wattles.** Partially trenched into the soil and staked, straw wattles are another effective means to control erosion.
- **Stormwater Manual.** WDOE's "*Stormwater Management Manual for Western Washington*" contains detailed information about these and other useful BMPs for erosion control.

Bank Erosion Controls

Exposed soils on banks and slopes are susceptible to erosion and can result in significant sediment loads. If steep banks are sloped back or if dredge spoils must be placed uphill from the work area, then measures should be taken to minimize any potential erosion. Where exposed earth is adjacent to a watercourse, controlling erosion can be as simple as seeding as soon as possible to establish vegetative cover and prevent sediment entry into the watercourse during the rainy season.

- **Erosion Control Seed Mix** - Any exposed soils should be immediately seeded with an appropriate seed mix such as:

Chewings or annual blue grass	40%
Festuca rubra var. commutata or Poa ann	
Perennial rye	50%
Lolium perenne	
Retop or colonial bentgrass	5%
Agrostis alba or Agrostis tenuis	
White dutch clover	5%
Trifolium repens	

Monitoring:

- Visual or measured monitoring for turbidity should be conducted every hour.
- Monitor at the upstream edge of the *Immediate Maintenance Dredging Work Zone*, and at the downstream *Point of Compliance*.
- Record observations on a Water Quality Turbidity Monitoring Report Form.
- Each time there is an observed differential in turbidity, additional BMPs listed above should be implemented.
- Should three successive hourly visual monitorings continue to identify problems after all practicable BMPs have been implemented; the operator will contact the Department of Ecology or the Lummi Naural Resources Department for work conducted on the Lummi Indian Reservation and advise them of the situation. The purpose of the phone call is to report the occurrence, discuss BMPs being employed and consult with the department on appropriate actions to address the situation.

HAND MAINTENANCE

Introduction

Maintaining watercourse drainage using only hand tools is a technique that humans have utilized since agricultural practices began. It is simple, when you see grass or other types of obstructions blocking a channel and flooding a farm field, reach in and pull it out. Nova Pacific Environmental working out of Vancouver B.C. has developed a system to utilize this age old practice as a more environmentally benign way to maintain drainage. Crews can work down a channel pulling back grass and removing obstructions to maintain drainage with minimal impact to aquatic habitat.

Permits

Any work below the ordinary high water mark of natural or modified natural watercourses requires a Hydraulic Project Approval from the Washington State Department of Fish and Wildlife (see Permitting Factsheet #1). Work within critical areas also requires a Natural Resource Notification of Activity with Whatcom County (see Permitting Factsheet #3). A Drainage Improvement District can permit Hand Maintenance work through the development and approval of their Drainage Management Plan.



photo courtesy of Nova Pacific Environmental



photo courtesy of Nova Pacific Environmental



photo courtesy of Nova Pacific Environmental

Advantages

- Longer work window, June 15th to October 30th.
- Reduces impacts to fish and other aquatic resources.
- Eliminates the need for fish exclusion.
- Eliminates the need for water quality BMPs.
- Allows native riparian plantings to stabilize and function.
- Cost competitive alternative to maintenance dredging.

Disadvantages

- Treatments will likely need repeated over time. The need for hand maintenance will be reduced when combined with improved farm practices to reduce sediment inputs and when combined with Watercourse Re-vegetation to stabilize the streambanks and shade out undesirable aquatic vegetation.
- Not effective if sediment buildup is the primary drainage problem.

When To Use

Hand Maintenance may be a useful practice in many situations including:

- Where land use constraints prevent longer term solutions such as Watercourse Re-vegetation.
- As an interim means to maintain drainage as native tree and shrub buffers are established.
- As a low impact means to maintain isolated obstructions in areas with riparian vegetation.

Hand Maintenance BMPs

1. Work must be completed between June 15th and October 30th.
2. Work will take place using hand tools from the top of the bank whenever possible.
3. If workers must work from channel bottom, areas with gravel substrate will not be disturbed.
4. If workers must work from channel bottom, sediments will not be disturbed and allowed to move downstream.
5. If sediments are disturbed, water quality protection BMPs must be implemented (see BMP Factsheet #16).
6. Native woody vegetation will be left intact as much as possible.
7. Work must be conducted during favorable weather and low water conditions. If heavy rain occurs unexpectedly, delay maintenance until water levels recede.



Informational Factsheets



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Drainage Management



Informational Factsheet #18

WATERCOURSE CLASSIFICATIONS

Introduction

Watercourses in lowland Whatcom County may often look similar but have very different histories and sources. This classification system will help to define watercourses so you will know what permit requirements and Best Management Practices (BMPs) are necessary in order to perform drainage maintenance work. Watercourses are defined primarily by their history and source of water. The following definitions will apply to watercourses occurring within Whatcom County Drainage Improvement Districts (DIDs) or other agricultural lands:

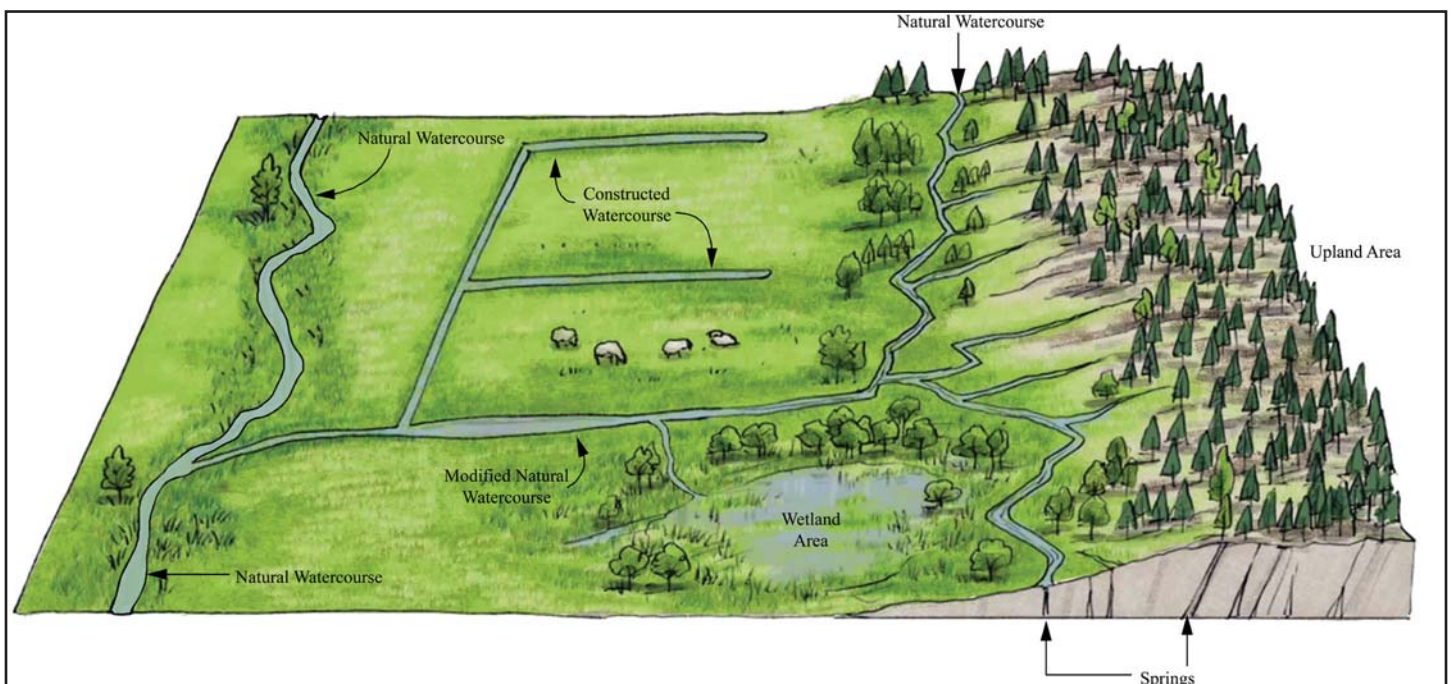
Natural Watercourse (Red)

Natural watercourses have not been significantly altered from their historical flow path or floodplain in any manner and have headwaters (usually from wetlands or springs). Natural watercourses do not typically exist within DID boundaries of Whatcom County and maintenance work on natural watercourses is not addressed by a Drainage Management Plan (DMP). Any kind of work in or around a natural watercourse will require individual permitting.

Modified Watercourse (Yellow)

Modified watercourses are historically natural systems that have been previously diverted, dredged, straightened, and/or diked.

- Appropriate permits including a HPA from WDFW are required for any drainage maintenance work. A completed and approved DMP packaged with permit applications will enable WDFW to issue five year HPAs allowing drainage maintenance work on these watercourses.
- A DMP must be approved by Whatcom County Planning and Development Services before any maintenance activities can occur within 150 feet of any "shoreline" watercourse and within 100 feet for all other watercourses.
- Permit applications for work on modified watercourses must also be sent to the Army Corps of Engineers (ACOE). Maintenance exemptions may be granted for some watercourses or ACOE permits may be required.
- BMPs listed in the DMP must be implemented to minimize impacts to fish and water quality and to

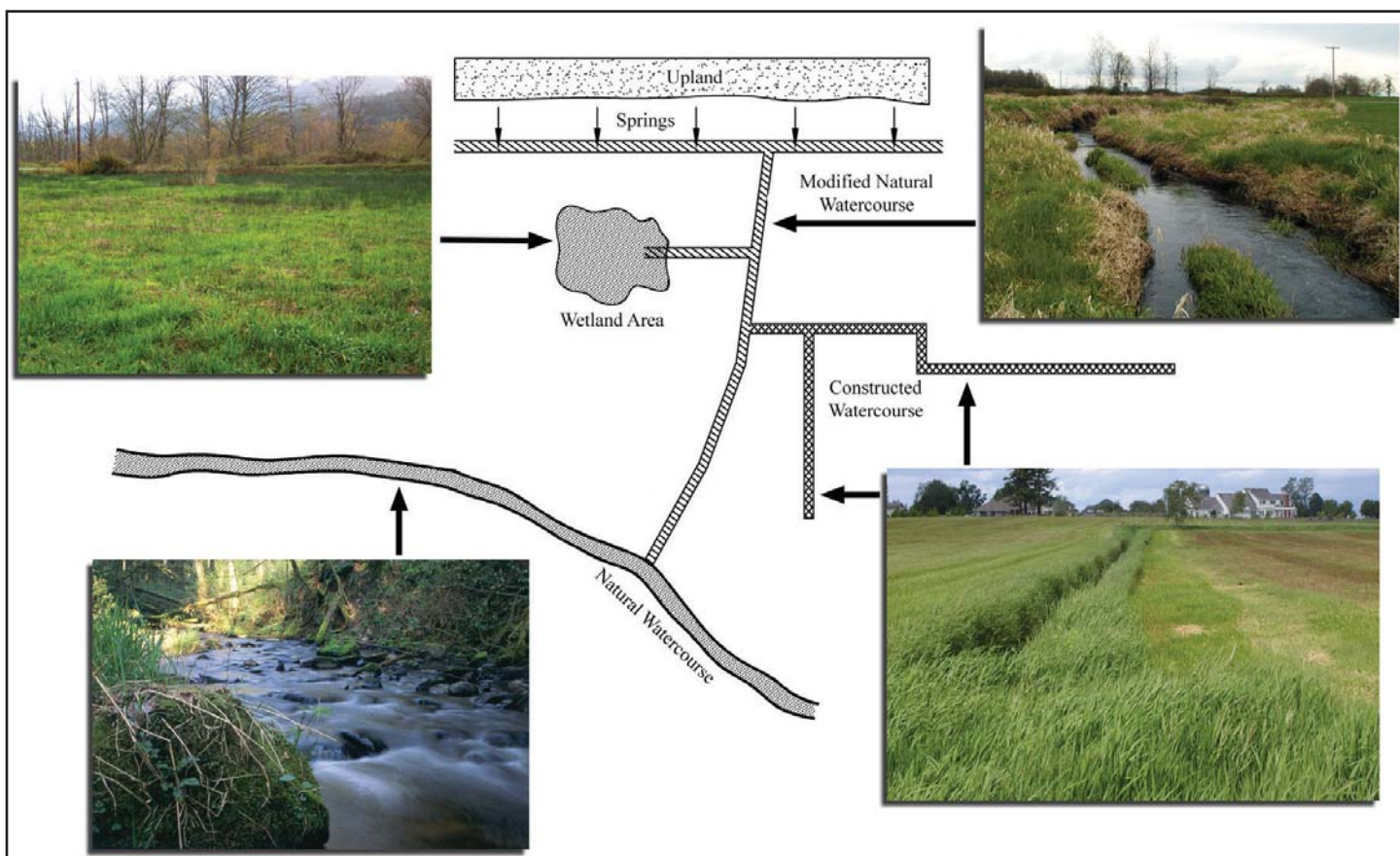


avoid violation of State Water Quality Standards or Tribal Water Quality Standards for lands under the jurisdiction of the Lummi Nation Natural Resources Department.

modified watercourses downstream. If water is present, BMPs listed in your DMP must be implemented to avoid violation of State Water Quality Standards or Tribal Water Quality Standards for lands under the jurisdiction of the Lummi Nation Natural Resources Department.

Constructed Watercourse (Green)

Constructed watercourses, also known as ditches, convey drainage water from an individual farm, or supply water to an individual farm property. Constructed watercourses do not have headwaters or other natural water sources. They may hold water permanently or intermittently. The presence of water necessitates use of Best Management Practices. Drainage Maintenance work on constructed watercourses can be done without permits as long as the work does not impact natural or





Example Watercourse Classification Map

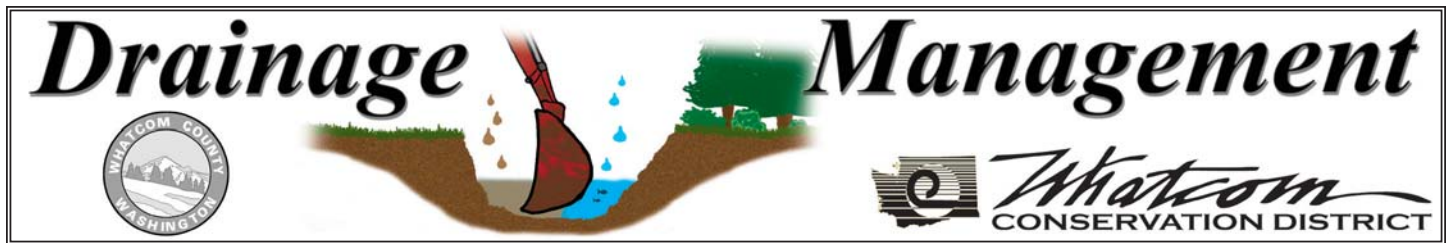
- Constructed Watercourse
- Modified Watercourse
- Natural Watercourse



Mar, 2009
Cartographer: Andrew Phay



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Informational Factsheet #19

DRAINAGE WATER QUALITY

Introduction

Water draining off a farm, whether from subsurface drains or from overland flows, presents an opportunity for pollution to enter watercourses and result in a violation(s) of water quality standards. The pollutants that are most likely to be generated from agricultural operations or Drainage Improvement District (DID) operations include:

- Pathogens (fecal coliform, *E. Coli* bacteria)
- Nutrients (e.g. Nitrates and Phosphorus)
- Pesticides (insecticides, fungicides, herbicides)
- Sediment (field runoff, bank failures, stormwater from development)

Landowners may be held responsible for pollutants released into watercourses from their land. DIDs also may be held accountable for the quality of water leaving their district boundaries, much like cities and other municipalities are held responsible for their stormwater releases. Both can be subject to \$10,000/day fines for water quality violations.

Under certain circumstances, DIDs may be required to obtain a municipal stormwater permit. One way this could happen is if a third party petitions the Washington State Department of Ecology (WDOE) or the Environmental Protection Agency (EPA) to determine that the DID is a significant contributor of pollution to surface waters. The DID need only be the conduit and not the source of the pollution. A stormwater permit will impose significant regulatory burdens, see *Factsheet #2 Water Pollution Control Acts*. DIDs should work closely with landowners to ensure that landowners' operations result in clean water leaving their lands and entering the drainage system.

Water Quality Guidelines

Farmland drainage systems in Whatcom County typically follow a familiar pattern. Water is collected in subsurface drains, which flow into constructed watercourses, which lead into modified and natural watercourses. Finally it is discharged into Bellingham Bay, Lummi Bay, Birch Bay or Drayton Harbor. Along

the way water can be used for a variety of beneficial uses including: drinking, irrigation, crop washing, livestock water, swimming, boating and for shellfish culture. Poor drainage water quality can affect the usefulness of the water supply for downstream members of your community.

This same water supports fish (including Endangered Species Act listed species) and other aquatic life. Important water quality criteria include water temperature and dissolved oxygen levels. Both criteria are critical to fish life and are directly affected by land uses, specifically the quality of or lack of riparian buffers (native trees and shrubs) along watercourses.

Criteria for drainage water quality are based on end use and the potential impact on aquatic habitat. The drainage water quality criteria selected should not alter or impair the use of the water sources for other purposes. For example, water with high levels of pathogens is not available for downstream vegetable farms to irrigate their crops because of the potential for contamination and resulting illnesses.

Water Quality Monitoring

The California spinach *E. Coli* outbreak of 2006 underscores the potential for having widespread and costly impacts due to poor water quality. Short of such drastic effects on people, fish or animals, water quality sampling is necessary to determine if drainage water is polluted beyond the water quality standard.

When to Sample

Samples should be collected when the risk of contamination is highest. The risk of drainage water contamination is elevated following the first significant rains of the season. It is also higher when there are increased activities on the ground such as when farmers are spreading manure, commercial fertilizers, or pesticides.

Where to sample

Landowners may consider sampling immediately

upstream and downstream of their property and a Drainage Improvement Districts may want to sample at:

1. Its boundaries to see if it is a potentially significant contributor to pollution.
2. A specific area where there is a suspected source of pollution.

Collecting and Storing Samples

The laboratory should be able to provide containers for samples. Samples may need to be kept at a cool temperature and need to be taken to the lab within a certain time for the test to be accurate. For pathogens, samples should be submitted to a lab on the same day of sampling. Be sure to ask the lab to confirm any of these requirements.

Watercourse Maintenance Activities

Watercourse maintenance, whether implemented by landowners or by Drainage Improvement Districts can be significant sources of water borne sediments that must be monitored and controlled. Detailed information about how best to do this can be found in *Factsheet #16 Water Quality Protection Measures*.

Controlling Contaminant Sources

The best way to manage pollutants in a watercourse is at the source, whether it be an agricultural operation, development, or human influenced stream bank erosion. *Factsheet #21 Bank Stabilization Techniques* and *Factsheet #22 Farm Practices* provide detailed information on how to manage these sources.

Stormwater Management Monitoring

Although it is not required to have a stormwater permit and to monitor regularly under that permit, a DID should be aware of the water quality conditions entering and leaving its boundaries. This is so the DID can proactively take steps to avoid being put under permit by encouraging landowners within its boundaries to take steps to protect water quality. Also, since cleaning ditches is expensive, adopting a policy that discourages erosion and sediment runoff from fields can save everyone money.

River and stream water quality monitoring data are available from Washington Department of Ecology (WDOE). WDOE maintains a website at: http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html#4. Another source of information is your local Watershed Planning Unit. For Water Resource Inventory Area No. 1 (WRIA1), which covers most of Whatcom County, the Whatcom County Public Works Department collects and maintains water quality data. The DID may want

to conduct some sampling to establish a “baseline” of information. Baseline conditions are those which exist before some event that affects water quality occurs, such as development in the watershed or addition of an industrial discharge. Comparing data collected before and after an event is one way of assessing its impact on water quality.

Additional means to control contaminant sources:

Controlled Drainage

Controlled drainage refers to holding back water within a ditch or reservoir by means of an instream structure. Such a structure would have adjustable or removable boards to control runoff.

- For the first rainfall of the season or if there is rainfall soon after manure, fertilizers or pesticides have been applied to the field, water would be impounded to prevent contaminated water from immediately entering a sensitive watercourse.
- The drain water could be held for treatment or released later in the season when stream flows are higher.
- These same structures could be used to impound water for passive subsurface irrigation during the summer growing season. Control boards would be removed in the spring to allow cultivation, then replaced in the summer for subsurface irrigation, then removed again in the fall for harvest.

Interrupting Macropores

Direct movement of manure or fertilizers to subsurface drains can occur through macropores, relatively large holes or cracks in the soil that allow direct access from the soil surface to the subsurface drains. If these macropores can be interrupted and the direct conduit to the drains closed, the soil will act as a filtering agent to allow nutrients to be taken up by the crop and pathogens to die off in the soil. Macropores can be interrupted by tilling the field before applying manure.

Subsurface Drainage System Control

Discharges from subsurface drainage systems may contain nutrients or other deleterious substances that are toxic to fish or that degrade water quality for irrigation purposes. Discharged water from subsurface drainage systems may be controlled by:

- Installing a water control structure at the downstream end of the drainage ditch.
- Having all subsurface lateral drainage lines connected to a collector pipe. A control valve on the collector pipe may then be used to control discharge of contaminated drainage water.

Drainage Management



Informational Factsheet #20

WATERCOURSE RE-VEGETATION

What is it?

Watercourse re-vegetation is the removal of noxious weeds and planting of native trees and shrubs on the banks and land adjacent to watercourses.

Why is it called re-vegetation?

Most watercourses had native vegetation growing on their streambanks at one time. Vegetation was often removed thinking that improved drainage would result. The long term result, however, has been poor drainage due to the growth of invasive Reed canarygrass. Re-vegetating the streambanks with native trees and shrubs will recreate shade and inhibit the growth of invasive grasses.



Channel full of Reed canarygrass

Why do it?

Historically Drainage Improvement Districts (DID) and many landowners have had a scorched earth policy of removing all vegetation from the banks of watercourses. Trees and shrubs can get in the way of maintenance equipment. Trees and shrubs are also materials that beavers use to dam up the watercourse and flood farmland. In light of these perceived disadvantages, why have 26 miles of DID watercourses in Whatcom County been re-vegetated over the past four years with more planned in the future? Read on and you will find that there are significant advantages to re-vegetating the banks

of watercourses.

Perhaps most important to landowners is that re-vegetating the banks and land adjacent to a watercourse can save money otherwise spent on dredging because the shade-providing and bank-stabilizing vegetation can lengthen the interval between channel cleaning. The roots and shoots stabilize stream banks and reduce erosion. If the dirt doesn't get in the channel to begin with, then you don't have to pay to get it out. Dense infestations of aquatic weeds, like Reed canarygrass, inhibit the flow of water. As the water flow slows, sediment falls out and is deposited in the channel. The shade created by trees and shrubs suppresses the growth of grass and helps keep the water flowing.

Maintenance activities such as dredging kill fish and remove habitat features that fish require for survival. State law requires that a Hydraulic Project Approval (HPA) application be denied when, in the judgment of the WA Department of Fish & Wildlife, the project will result in direct or indirect harm to fish life unless adequate mitigation can be assured by conditioning the HPA or by modifying the proposal (WAC 220.110.30). Further, dredging projects shall incorporate mitigation measures as necessary to achieve no-net-loss of productive capacity of fish and shellfish habitat (WAC 220.110.130). The requirement for mitigation does not include irrigation ditches, canals, storm water run-off devices, or other entirely artificial watercourses, except where they exist in a natural watercourse that has been altered by humans (WAC 220-110-020(83)).



Even a narrow Hedgerow of native shrubs will shade out the Reed canarygrass

Native trees and shrubs mitigate against negative impacts to fish and fish habitat by:

- Protecting the stream bank against erosion.
- Preventing the invasion of noxious weeds.
- Reducing the negative impact of weeds growing in the channel - short and long term.
- Providing shade, thereby reducing water temperature otherwise heated due to direct exposure to sunlight.
- Dissipating concentrated overland flow, filtering sediment, and increasing infiltration in the planted corridor area adjacent to stream.
- Providing other fish habitat benefits – leaf litter, small woody debris, terrestrial insects dropping into the water and cover from vegetation where possible.
- Integrating the riparian area into a functional part of the agro-ecosystem, rather than a strip of unmanaged land producing undesirable impacts on the farming operations of landowners.

Other advantages to Bank Re-vegetation include:

Visual – Riparian vegetation increases the attractiveness of the farm environment by contributing blooming plants, fall colors, and a visual distinction between fields. A hedgerow of native woody vegetation is much more attractive than the look of tall, dry, unmowed grass.

Water Quality – Flooding or heavy rainfall can cause concentrated overland flow that carries silt and other materials. The above ground part of vegetation breaks up concentrated flow and traps and filters out sediment before it reaches the open watercourse, thus increasing infiltration of water. Roots of vegetation can absorb nutrients and other compounds from the infiltrated water.

Bank Stability – Woody plants form a dense root mat in the soil, preventing bank erosion.

Fish Habitat – If the watercourse has fish in it, the improvements to fish habitat from riparian re-vegetation are direct. If the watercourse is not fish bearing but flows into a watercourse that is fish bearing, the benefits are indirect.

Shade – Shrubs and trees growing on or at the top of the bank will in time produce dense shade. Shade over water reduces the heating effect of direct sunlight, thereby improving fish habitat. Shade inhibits the growth of undesirable vegetation in ditches and on ditch banks that may restrict water flow.

Food – Vegetation supplies food to fish both directly and indirectly. Insects falling into the water from the

leaves are eaten by fish. Indirectly, vegetation provides leaf litter and other organic matter that is eaten by the insects that are in turn food for fish.

Low Cost – Watercourse bank planting is a relatively inexpensive technique for bank stabilization and required mitigation. The plants can be installed relatively quickly with a minimum amount of labor. Funding for this work can often be found from governmental agencies or non-profit groups.

Increased Bio-diversity – Native vegetation planted along ditch banks increases the range of plant and animal species (organisms that live in or on the vegetation) that can be found along the waterway. Native woody plants will primarily attract native bird species that do not adversely affect crops or livestock and may provide some benefit such as insect control.

Disadvantages of Bank Re-vegetation

Weeds – Planting must be managed to prevent noxious weeds from becoming established. A densely planted area is not vulnerable to weed infestation. However, if not mowed regularly, weeds may become established in the “edge” area between the planted bank and field.

Insects and Plant Diseases – Select native plant species because they usually do not host problem insects or plant diseases that may spread to nearby crops. Non-native plants tend to attract nuisance species such as European starlings.

Birds – Many landowners are concerned that planting trees and shrubs will increase the local bird population. While good for bio-diversity and insect control reasons, most berry, tree fruit, and corn producers do not want to do anything that will increase the number of birds that may feed on their crops. However, native plants tend to attract native song birds that do not cause problems. Non-native plants may attract non-native nuisance bird species such as European starlings that can have significant impacts to crops and livestock.

Rodents and Ungulates – Voles, mice, beaver, pocket gophers, and muskrats are all rodents that can become a problem with increased vegetation along a ditch. Ungulates such as deer and elk may use the cover of vegetation planted along the ditch to move into a farm property.

Other animals and people – Predators such as coyotes can use vegetation along watercourses as cover. Vegetation can also provide cover for people entering the farm property without knowledge of the landowner.

How to Re-vegetate a Bank

Technical Considerations

For planting purposes the bank slope should be no steeper than 2:1 (2 horizontal lengths for 1 vertical length). If soils are fine silts and sands and planting is the only stabilization technique being used, lower gradient slopes of 3:1 to 4:1 are more appropriate.

Plantings are most successful on banks where moderate erosion is anticipated and where the bank is not actively slumping. If slope failure is extensive or there is erosion at the toe of the bank, planting vegetation on the bank will not solve the problem. In these situations another technique of bank stabilization should be used in conjunction with the streamside planting.

Planting should take place in original soil, not in fill. Fill areas should use bio-engineering to stabilize the disturbed soil. It is important that the planting develops into a stable ecosystem that will require minimal maintenance once established. Woody plant material takes time to produce enough root and stem growth to stabilize and protect the bank. Seeding grass or grass and clover mixtures will provide faster green cover until the woody material becomes established. It may be necessary to use interim non-plant protection measures, such as biodegradable or synthetic geotextiles, or crib walls. Vegetation cover alone may not protect the bank from eroding in high velocity flows.



Hedgerows can be colorful and provide food for native songbirds

Plant Selection

Effective bank revegetation uses a mix of plant species to incorporate structural diversity along the bank. Plants should be selected based on their ability to grow under the conditions where they will be planted and on their capability to perform the desired function. Functions may include quick growth, strong roots to resist erosion, ability to produce shade, production of berries for birds (or no berry production for no birds) or the ability to produce a marketable crop.

For all methods described below, it is important to get expert advice on the types of plant species that will

survive in specific conditions and the requirements for planting techniques and maintenance to ensure the planting will thrive.

When to Plant

Ideally planting should be done in the spring or late fall. Planting can be done at other times of the year; however, plant survival is likely to be lower. Adequate moisture must be supplied to the plants throughout the growing season, particularly if un-rooted cuttings have been used. Solid seedling protectors should be installed on each plant to protect the plant from rodent damage and to facilitate maintenance.



Deciduous trees provide good shade over watercourses

Monitoring

Plantings should be monitored throughout the growing season to make sure the plants are doing well. Soil moisture may be dependent on the depth to the water table; soils may dry out during low water in mid summer. Frequent causes of planting failures are weed competition, drought, browsing by small and large animals, and incorrect plant selection for the site.

Live Staking

Cuttings from woody plants are often readily available and easy to install. This is referred to as 'live-staking'. Live staking is used in many bio-engineering practices to stabilize soil or stake other materials in place. The plants' roots stabilize the bank by binding soil particles together and removing moisture from the soil.

The best time for stake installation and harvesting is the late fall or early spring. Get professional advice when considering planting at other times.

Ideally cuttings should be planted as soon after collection as possible. If the cuttings are to be stored, they should be kept moist and stored at low temperature (-1° C to -4° C).

Live staking does not immediately provide slope

stabilization; it takes a couple of years for the plants to become established. Plantings on moist, well drained banks that are not subject directly to erosive forces will be most successful. Seeding will provide protection to the exposed soil. The stakes in Figure 2 also have plastic tubing around the base to protect the plantings from rodents.

Installation of Live Stakes

The stake should be no smaller than the diameter of a thumb or index finger, 1/2" to 1 1/2", and 36" long. Be sure to protect the cuttings from drying out between the harvesting and planting.

Install the stakes in a gridwork approximately 3' on center. Actual spacing will depend on the plant type and eventual size of the plant.

Push the stake in by hand or tap it in gently with a soft mallet until two-thirds of the stake is below the ground. If the soil is very hard use a dibble tool or other type of probe to make a pilot hole.

Presoaking cuttings 24 to 72 hours before planting has shown to increase plant survival rates. However, soaking also softens the wood. In order to prevent damage to the cutting, a probe should be used to create a pilot hole. The pilot hole should be slightly smaller than the diameter of the cutting to ensure good soil-plant contact. If the hole is larger than the cutting, pour a slurry of water and native soil into the hole with the cutting. In all cases, press down the soil around the base of the planted cutting with your boot in order to collapse any air pockets near the cutting. Irrigate after planting if possible.



Willow livestakes planted for bank stabilization

Container or Root Stock Planting

Container grown and bare root stock can be purchased from nurseries or transplanted from areas away from the slope. Pre-rooted plants, as opposed to live staking, can offer a faster but more expensive solution to some slope

stabilization projects. Many more species of plants are available as rooted than as live stakes.

Planting of Container or Bare Root Stock

Loosen the root balls before placing the plants in pre-dug holes. The plants should be monitored and irrigated until the root system is well established.



Hedgerow after one summer of growth

Seeding

Seeding with grass and clover creates a shallow root zone in the first foot of soil. This protects the soil surface from surface runoff and wind. Seeding is usually used in conjunction with other planting techniques and is intended to provide temporary erosion control. Some grass species will provide very rapid green cover if required. However, grass can be very competitive with the woody species, so needs to be controlled in the area around the planted shrubs or trees.

Woody vegetation provides stronger bank protection against slumping.

For best results a custom seed mixture for the site and the season is recommended. WA Dept. of Ecology (WDOE) recommends the following seed mix for temporary erosion control:

Chewings fescue or annual blue grass	40%
Festuca rubra var. commutate or Poa ann	
Perennial rye	50%
Lolium perenne	
Retop or colonial bentgrass	5%
Agrostis alba or Agrostis tenuis	
White dutch clover	5%
Trifolium repens	



One season growth of seed mix planted in the spring

WATERCOURSE BANK STABILIZATION TECHNIQUES

Introduction

You know how expensive it is to clean a ditch. Costs of repeated work due to bank failure can be avoided by maintaining a proper bank slope and appropriate vegetative cover. When a bank sloughs into the channel, not only does it reduce how much water can pass through the channel, it also releases sediment downstream that negatively impacts water quality and fish habitat. The suspended sediment can clog fish gills and smother spawning eggs in gravels downstream. Good bank stabilization is good for your pocket book and for the environment.

The Washington Department of Fish and Wildlife has published “Integrated Streambank Protection Guidelines” that provide much more detailed ways to assess and design bank stabilization projects than what is provided in this Factsheet.

Soil Structure

In low gradient streams and constructed ditches typical in western Washington, the soil structure and vegetation are the most important aspects of system stability. Sands, peat, and loose loam soils often have bank wall failures. For these soils the banks of a watercourse should be generally sloped between 2H:1V to 4H:1V (horizontal to vertical ratio). Gently sloped banks will help maintain



Bank failure caused by vegetation removal

bank stability, prevent slumping and filling in of the channel due to erosion, and will increase flood capacity. Roots from grass, shrubs or trees are the cement that will bind together soil particles and prevent failures.

Bank Stabilization Techniques

Bank stabilization techniques vary according to site conditions, potential cause of failure, and consideration of positive or negative impacts to fish habitat. Common techniques include:

- Erosion Control Seeding
- Bank Re-vegetation
- Bio-Engineering
- Large Wood or Rock Revetments

Erosion Control Seeding

Seeding is good for immediate protection of the soil surface and prevents erosion from runoff and wind. Seeding is often used in conjunction with tree and shrub plantings that provide much more long term bank stability. Seeding can be quickly and inexpensively applied to slopes. On steeper or more unstable slopes seeding should be used in combination with straw, erosion control fabric, or other measures. Seed mixes designed for erosion control can be purchased from most seed distributors and should follow the following formula:

- Erosion Control Seed Mix - Any exposed soils should be immediately seeded with an appropriate seed mix such as:

Chewings or annual blue grass	40%
Festuca rubra var. commutata or Poa ann	
Perennial rye	50%
Lolium perenne	
Retop or colonial bentgrass	5%
Agrostis alba or Agrostis tenuis	
White dutch clover	5%
Trifolium repens	



Cover crop using Erosion Control Seed Mix



Dense native tree and shrub planting

Bank Re-Vegetation

In addition to seeding, planting native trees and/or shrubs along the banks offers more significant bank protection. The root systems of the native trees and shrubs can withstand the erosive capability of higher water flows in a natural way. Bank re-vegetation is also very effective in mitigating the erosive effects of overland flood flows eroding down the banks as waters recede.

Factsheet #20 Watercourse Re-vegetation provides detailed information about bank planting. Common methods include:

- Hedgerows – Narrow (15') width native shrub buffers densely planted to maximize bank stabilization and stream benefit without impacting adjacent farm fields.
- Riparian Forest Buffers – Wider (35' minimum) width native tree and shrub plantings designed to restore some natural watercourse functions.



Established tree and shrub planting

- Livestaking – Native willow species and red osier dogwood can be planted with vegetative cuttings at low cost. Plant densely close to the water edge for best results.
- Bare Root or Container Plants – Local nurseries produce and sell native trees and shrubs either bare root (without soil) or containerized (in pots). Bare root plants are less expensive but have a shorter season within which to plant (December to March). Containerized plants are more expensive but are available nearly year round.

Bio-Engineering

Bio-engineering techniques for bank stabilization incorporate the use of riparian vegetation and wood cuttings that are installed in the bank to provide structural stability. Bio-engineering techniques are used to enhance slope stability, control sediment generation, and maintain bio-diversity. Native willow species and red osier-dogwoods are the most common choices of woody plant material to work with. Some bio-engineering techniques include:

- Wattles - Bundles of live cuttings staked into trenches. The wattle placement breaks up the slope by creating terraces with shallower slopes than the original bank. As the cuttings take root, the root system binds the soil together and helps to stabilize the bank.
- Brush Mattress - An interlaced layer of live branches placed on the bank and held in place with untreated twine and live or dead stakes. This technique is useful where high flows may erode exposed banks before vegetation is established
- Brush Layers - Horizontal alternating layers of soil and live branches. This creates a continuous reinforced bench within the bank. This technique is useful in projects that require cut and fill, where



Vegetated Geogrid using Coir fabric and Willow livestakes

there are large quantities of loosened soil on the slope, or where the bank is slumping.

- **Vegetated Geogrids** - Similar to brush layers except natural or synthetic geotextiles are wrapped around the exposed soil between brush layers, anchoring the ends of the geotextile in the fill material. Vegetated geogrids are appropriate for steeper slopes that have limited room for bank shaping. This technique is used to reinforce the area of toe erosion and for projects that require filling or rehabilitation of seriously eroding and slumping banks.
- **Tree Revetments** - Involve the grading of a slope to 2H:1V then cabling durable green coniferous trees, such as cedar or pine into the bank slope. The trees should have a diameter of 18" to 36". The branches of the trees will dissipate water velocities and the stream's energy. Sediment settles out behind the branches and can help to rebuild an eroded bank. This technique is most effective when used in locations where ditch banks are rapidly eroding and require protection from toe erosion and bank scouring. Other bio-engineering or planting is recommended to protect the upper banks.
- **Cribwalls** - Basically a 'live' log wall, built crib-style, to protect eroding banks. Vegetation is planted between the logs used to build the wall. This reduces the water velocity and provides shelter for fish. This technique is useful when slopes cannot be cut back or to prevent toe erosion in large areas of scour. Cribwalls do not need to be built up the entire bank. Wattles or brush layers may be installed on the upper bank.
- **Vegetated Rolls** - Usually made of coconut fiber bound together with twine. However, these rolls may also be made of other materials that provide the same effect. The rolls are flexible and able to mold

to existing curves. Therefore, little site disturbance occurs during installation. This technique is useful for providing temporary toe protection of slopes while vegetation becomes established. It is not effective for permanent toe protection.

Rock Revetments

Rock revetments were once commonly used for bank stabilization, but now should be considered a last resort because of their damage to aquatic resources and to permitting difficulty. Only where banks are subjected to high velocity flows or where the bank toes need to be stabilized, may revetments be necessary. When a bank is armored with rock, there tends to be other bank failures upstream or downstream as the watercourse adapts to the constriction. Rock-armored banks also negatively impact fish habitat by: providing minimal cover, creating turbulent conditions, and preventing bank re-vegetation.

- **Riprap** is the placement of angular rocks of various sizes along the stream banks. The rocks lock together to help to stabilize the banks thus providing a hard layer of protection outside of the softer, easily erodible stream bank materials like sand or fine sediments. The advantage of riprap is that it remains stable at most flow levels, it is durable, easy to install and easy to maintain. However, large projects can be costly and riprap restricts natural channel movement, looks unnatural, and can cause other erosion problems upstream and downstream of where it is placed.
- **Rock Toe Keys** are the bottom half of the riprap structure. These are used in conjunction with other bio-engineering techniques that protect the upper bank. The rock toe keys stabilize the toe and are installed up to the normal water level.

Rock Revetment combined
with Large Woody Debris



- Joint Plantings incorporate riprap and live stakings to produce a vegetated armored bank. These are effective in areas where the banks require more protection than vegetation alone can provide and require some vegetation for habitat creation. The vegetation and root structure will bind the riprap to the slope and create more natural looking bank. Establishing vegetation in riprap can be tricky and requires monitoring and irrigation during the first years to ensure plant survival.
- The use of large woody debris integrated into the bankline will enhance habitat features and enhance bank stability.

Tips for Bank Stabilization

Bank stabilization on natural or modified watercourses using 'soft' engineering techniques, such as planting and/or seeding, may be undertaken pursuant to a Drainage Management Plan or farm plan at any time of year with only a 10 business day Critical Areas notification to Whatcom County Planning and Development Services.

- Bank stabilization on constructed ditches can be done at any time, however, measures should be taken to prevent any sediment release or harm to any fish. See *Factsheets #16 Water Quality Protection Measures* and *Factsheet #15 Fish Protection*.

- Bank stabilization using any form of 'hard' engineering technique, such as bio-engineering or rock revetements on natural or modified natural watercourses will require a Washington Department of Fish and Wildlife Hydraulic Project Approval (HPA) and is likely to require a permit from the Army Corps of Engineers. See *Factsheet #4 Agency Contacts Requirements* and *Factsheet #1 Hydraulic Project Approval*.
- All works must be conducted during favorable weather and low water conditions.
- Works must be conducted in isolation of flowing water. The method chosen should be appropriate for the amount of flowing water in the watercourse. For further details see *Factsheet #16 Water Quality Protection Measures*.
- Work must be undertaken in a manner so as to prevent the release of silt, sediment or sediment-laden water, raw concrete or concrete leachate, or any other deleterious substance. For further details see *Factsheet #16 Water Quality Protection Measures*.
- Machinery must work from the top of bank and not from within the watercourse.

Drainage Management



Informational Factsheet #22

FARM PRACTICES & DRAINAGE MAINTENANCE

Introduction

Adequate drainage is an essential component of any agricultural operation in Whatcom County. Maintaining drainage in open watercourses can have detrimental effects on aquatic life and water quality. Drainage maintenance is also expensive. Removing sediments (dredging) from a modified watercourse can cost as much as \$3.00/linear foot of channel when excavation, fish protection and water quality protection Best Management Practices (BMPs) are included. Mitigation for the impacts to fish habitat can add considerably more expense to any maintenance project.



The most cost effective action that a Drainage Improvement District (DID) or landowner can take is to prevent sediments from reaching the watercourse in the first place. To do this, a landowner can implement appropriate farm practices and a DID can proactively encourage landowners within their districts to adopt farm practices that prevent runoff and sedimentation. The result of better farm practices will be less channel maintenance expenditures and less need for high assessments to fund channel maintenance.

Impacts can come from urban development as well as from agricultural operations. Often the urban sources are upstream from an individual farm or DID boundary. Adopting policies that will encourage those landowners to follow best management practices to prevent sediment are to everyone's benefit.

Agricultural Operations

The natural and modified natural watercourses that are often a part of a DID system are considered critical areas and are protected under Whatcom County's Critical Areas Ordinance. Like DIDs, farmers have responsibility under the ordinance to ensure that their actions do not negatively impact these environmentally sensitive areas. Farmers can do this by developing and implementing Conservation Farm Plans.

A conservation farm plan identifies farming and ranching activities and the practice(s) necessary to avoid potential negative impacts (resource concerns) from those activities. Practice selection depends upon the types of livestock raised and crops grown. Some examples of common practices that will help to prevent farm related sediments from reaching watercourses include:



Filter Strips

A filter strip is a width of herbaceous vegetation located between crop land, pastures, or disturbed land and environmentally sensitive areas such as watercourses and wetlands and is designed to trap sediments and other contaminants.

- Used along the down slope edge of crop fields to protect an adjacent watercourse.
- Generally planted with perennial grass species.
- Traps and filters sediment and other contaminants before they reach the watercourse.
- Filter strip widths should be determined based on hydrologic soil characteristics, density and height of

- the filter strip vegetation, and runoff volume. The minimum width for sediment control is 20 feet.
- Size the width of filters to match seeding and harvesting equipment.
- Choose grass species that are able to take up high amounts of nitrogen and phosphorus, grow fast, and tolerate frequent mowing.
- Inspect the filter strip after major storm events and repair any gullies that have formed. Redistribute unevenly deposited sediment accumulation greater than 6 inches. Reseed disturbed areas.
- To maintain filter strip function, periodically regrade the filter strip area and re-establish the vegetation when needed.
- Filter strips are most effective when combined with watercourse re-vegetation using native trees or shrubs.



Hedgerow planting and filter strip buffering the watercourse from cornfield

Field Border

A field border is strip of permanent vegetation established at the edge of or around the perimeter of a crop field.

- Use perennial grasses or shrubs.
- Minimum border width may be mandated by Nutrient Management Plans.
- Locate borders around the entire perimeter of the field, or as a minimum, in areas where runoff enters or leaves the field.



Field border consisting of Douglas Spirea

- Design to accommodate equipment access and other operations.
- Select herbaceous plants and shrubs that provide habitat for beneficial insects. Mowing, harvesting, and pesticide applications should be scheduled to accommodate the life cycles of the beneficial insects.
- Or, select plants that provide a habitat that causes pest insects to congregate. Use mechanical, cultural, and/or chemical techniques to reduce pest populations when and where they congregate in the field border.

Watercourse Re-vegetation

Watercourse re-vegetation is the removal of noxious weeds and planting of native trees and shrubs on the banks and land adjacent to watercourses. Woody plants once existed along all natural and modified natural watercourses and even colonized many constructed watercourses. These plants provided many functions for fish and other wildlife and helped to buffer the water from adjacent land uses. Over the last few decades, these trees and shrubs have been systematically removed in an effort to improve drainage because fallen trees or broken limbs can fall in the channel and impede flow. The unintended result however has been decreased drainage capacity and the need for frequent maintenance due to increased field



Native shrub Hedgerow buffering watercourse

runoff and the the invasion of Reed canarygrass.

- Public or private funding is often available for watercourse re-vegetation through government agencies and non profit groups.
- Native trees or shrubs protect or improve water quality by creating shade that lowers the water temperature and helps to maintain or raise dissolved oxygen levels. Native plants also buffer the stream from land based contaminants such as sediment, nutrients and pesticides.
- Native trees or shrubs provide food and habitat for fish including Endangered Species Act listed Salmon species.
- Roots from woody plants create a dense mat that prevents erosion and bank failure.
- Trees or shrubs dissipate concentrated overland flow, filter sediment and increase infiltration away from

the stream.

- Shade created by native trees and shrubs also helps to control shade intolerant invasive weeds, primarily Reed canarygrass, that trap sediments and impede drainage.
- Riparian Forest Buffers include both native trees and



Native shrub Hedgerow shading watercourse

shrubs and are a minimum of 35' wide.

- Hedgerows consist of native shrub species and are 15' wide. Hedgerows are usually combined with a filter strip to ensure watercourse protection.

Livestock Exclusion

Livestock erode stream banks, releasing sediments and



Livestock exclusion fence preventing animal access to the stream

other contaminants that negatively affect water quality, fish habitat and drainage.

- Fences should be designed to contain the animal species targeted.
- Clean livestock watering sources should be provided well away from the watercourse.
- Plan for a buffer area (filter strip, field border,



Nosepumps provide livestock water away from the watercourse

riparian forest buffer, hedgerow) between fences and watercourses.

Cover Crops & Relay Crops

Grasses and other herbaceous plants established for seasonal cover protect field soils in the rainy season. Unprotected soils can erode into watercourses impairing water quality, degrading fish habitat and impeding drainage.

- Reduces erosion from wind and water.
- Increases soil organic matter.
- Prevents weed invasions.
- Provides supplemental forage.



- The cover crop should be harvested or tilled in as late as feasible to maximize plant growth and still prepare for the new crop.

Manure Management

Livestock operations of all sizes generate manure. When managed properly, manure is the best fertilizer for crop ground. But when managed poorly, manure can be a significant source of contaminated runoff.

- Dairies and other concentrated animal feeding operations are required to have custom Farm Conservation Plans that prescribe a system of collection, transfer, storage, containment and handling facilities. Protocols are identified to test and land apply manure. All of these practices help to keep waste out of surface and ground waters.
- Low-impact agricultural operations, defined by not exceeding one animal unit per acre of grazable pasture, are not required to have custom farm plans but should store, compost and utilize manure according to the Whatcom County "Tips on Land & Water Management" booklet available from Whatcom County Planning & Development Services or the Whatcom Conservation District.



Urban Growth & Stormwater Runoff

With increasing frequency, agricultural watercourses are impacted by stormwater runoff from upland development.

- Impervious surfaces (roads, driveways, roofs, etc.) prevent rainwater from naturally infiltrating the soil and instead send it downstream as stormwater.
- Increased flows may contain sediment and other contaminants that can impact drainage, water quality and fish habitat downstream.
- Increased flows can also erode watercourse banks, causing more impacts downstream.

Downstream landowners and elected DID commissioners should become involved early on in the planning stage of urban developments to help ensure that adequate consideration is given to their potential impacts on DID watercourses. This can be done by letting City and County planning departments know that the DID wants to weigh in on new development and by providing the contact information for where to send notices of permit requests. In addition, commissioners may determine that by receiving new stormwaters from upland developments they are providing an unfunded benefit to those developments. A DID may then choose to pursue collection of the operational maintenance costs from those developments. 85.32.050 RCW.



Growth in agricultural areas increases stormwater runoff

4 DEFINITIONS & ACRONYMS

Definitions

Bank – Means any land surface above the ordinary high water line that adjoins a body of water and contains the water except during floods. Bank also includes all land surfaces of islands above the ordinary high water line that adjoin a water body and that are below the flood evaluation of their surrounding water body.

Bed – The land below the ordinary high water lines of state waters. This definition shall not include irrigation ditches, canals, storm water run-off devices, or other artificial watercourses except where they exist in a natural watercourse that has been altered by man.

Best Management Practice (BMP) – Methods and techniques for minimizing nonpoint pollution; from Section 208 of the Clean Water Act.

Channel Maintenance – Removing obstructions from a watercourse to maintain drainage or flood control functions.

Conservation District – A subdivision of state government organized under Chapter 89.08 RCW.

Drainage Improvement District – A political sub-division of the state authorized under Title 85 RCW.

Hand Removal – To remove an obstructing object by using hand-held tools.

Hydraulic Project – Construction or performance of work that will use, divert, obstruct or change the natural flow or bed of any of the salt or fresh waters of the state.

Hydraulic Project Approval (HPA) – A written approval for a hydraulic project signed by the Director of the Department of Fish and Wildlife or his/her designee.

Large Woody Debris – Conifer or deciduous logs, limbs, or root wads twelve inches or larger in diameter.

Migration Corridor – The area in which an unrestricted watercourse will move in a natural state.

Mitigation – Activities that avoid, minimize, rectify, reduce, eliminate, compensate, or correct otherwise probable significant adverse environmental impacts.

Notification – Written announcement of intent to proceed with maintenance activities submitted to the appropriate jurisdiction.

Ordinary High Water Mark – The mark on the shores of all waters that will be found by examining the bed and banks and ascertaining where the presence

and action of waters are so common and usual and so long continued in ordinary years, as to mark upon the soil or vegetation a character distinct from that of the abutting upland.

Pool – A portion of the stream with reduced current velocity, often with water deeper than the surrounding areas.

Reach - As used in this Guide, is a homogenous length of watercourse that has a uniform set of physical, chemical and biological conditions.

Riffle – A shallow, gravelly area of a streambed with swift current, a shallow rapids where the water flows swiftly over completely or partially submerged obstructions to produce surface agitation, but standing waves are absent.

Riparian Vegetation – Plants that live along streams, ponds, lakes, wetlands, and other waterways that perform a number of vital functions affecting the quality of salmonid habitats as well as providing habitat for a variety of other wildlife.

Timing Window – Specific time period in which work is authorized and in which potential risk toward fish is minimized.

Waters of the State – All salt waters and fresh waters waterward of ordinary high water lines and within the territorial boundaries of the state.

Acronyms

BMP	Best Management Practice
CAO	Critical Area Ordinance
CWA	Clean Water Act
DID	Drainage Improvement District
DMP	Drainage Management Plan
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
GMA	Growth Management Act
HCP	Habitat Conservation Plan (Endangered Species Act)
HPA	Hydraulic Project Approval
ITP	Incidental Take Permit
JARPA	Joint Aquatic Resource Permit Application
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
SEPA	State Environmental Policy Act
SMA	Shorelines Management Act
TMDL	Total Maximum Daily Load (for water pollutants)
USCOE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish & Wildlife
WDOE	Washington Department of Ecology
WRIA	Water Resource Inventory Area

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5 APPENDICES

Appendix A -- Habitat Improvement Opportunities from Whatcom County Shorelines Master Program and Critical Area Ordinance

Where fish, fish habitats or other critical areas are impacted by drainage maintenance work, Habitat Improvement Projects (mitigation) must be provided to offset the impacts. WDFW is ultimately the agency that will determine what is needed for adequate protection of fish life. The standard of protection used is “no net loss”. No net loss equals:

- Avoidance or mitigation of adverse impacts to fish life; or,
- Avoidance or mitigation of net loss of habitat functions necessary to sustain fish life; or,
- Avoidance or mitigation of loss of area by habitat type. Mitigation to achieve no-net-loss should benefit those organisms being impacted (WAC 220-110-020 (56)).

Whatcom County also regulates critical areas, which include fish bearing streams. By developing a Drainage Maintenance Plan (DMP) you are presented many opportunities to creatively choose and apply mitigation measures. When presented for approval, a DMP will be examined to see that opportunities to mitigate are taken advantage of in the following order of preference:

- Have you avoided an impact altogether by not taking a certain action or parts of an action?
- Are you minimizing impacts by limiting the degree or magnitude of an action and its implementation?
- Will you be rectifying impacts by repairing, rehabilitating, or restoring the affected environment?
- Does your plan reduce or eliminate an impact over time by preservation and maintenance operations during the life of an action?
- Are you compensating for an impact by replacing or providing substitute resources or environments?
- Does your plan provide for monitoring of the mitigation and taking remedial action when necessary if the measure(s) isn’t functioning as intended? (Whatcom County Code Chapter 16.16 Article 8, Sep 2005) (See Step 9 below for guidance)

Avoiding Impacts

A DID can avoid impacts by adopting policies that reduce the need to disrupt the watercourse. For example, it is widely accepted that grass buffers can provide significant control of erosion and sediment. Encouraging landowners to plant and maintain a grass filter strip of an appropriate width along a watercourse can reduce a DID’s need to remove sediment through dredging. Similarly, planting trees along watercourses can “shade out” Reed canarygrass and improve fish habitat. Every year that passes without the need for dredging is a year that impacts are avoided.

Minimizing Impacts

The uniform removal of sediment along the entire length of the bottom of a watercourse may not be necessary to provide good drainage. Leaving some relief or bars where fish can hide from predators or breaks where food can be scavenged are some ways impacts can be minimized.

Rectifying Impacts

When cover (often canary grass or blackberries) is removed from ditch banks, what shade, leaf litter fall, and insects that would otherwise be available are lost. By planting native shrubs along the banks of the watercourse, these lost habitat functions can be restored.

Reduction by Preservation

Leaving existing native shrubs where they are by working around or over them is a way to preserve what habitat is there.

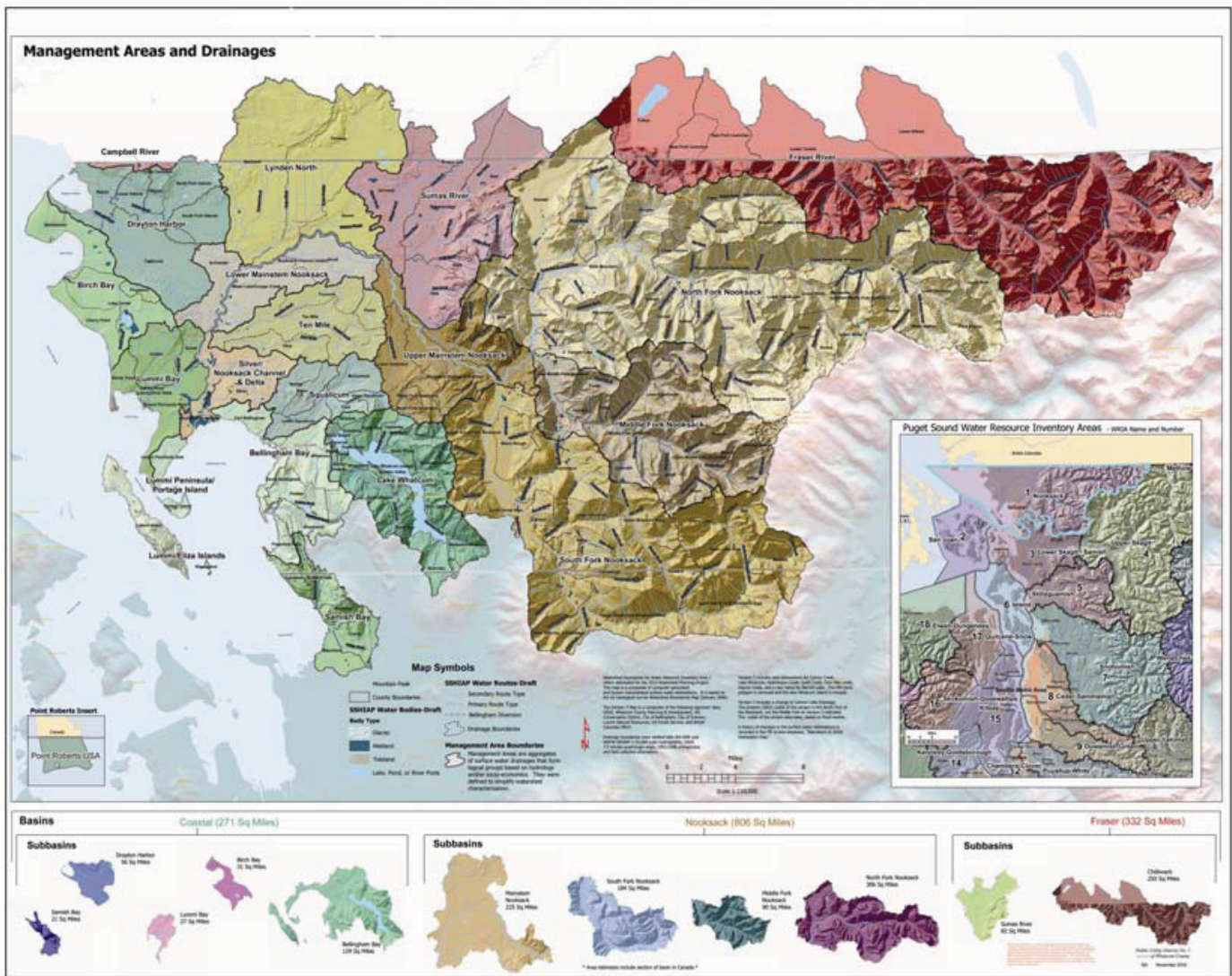
Substituting Environments

Historically, mitigation measures have been required on the site where the maintenance work was occurring. On-site mitigation such as planting native shrub hedgerows will continue as the preferred option because it rectifies the impacts and may help to avoid future impacts by reducing maintenance needs. However there are some site specific instances, such as road ditches, where the mitigating at the impact site may not be the best investment. Higher and sustained environmental lift or “bang for the buck” could result if mitigation is implemented elsewhere in the DID.

Shoreline Master Program Restoration Priorities In Agricultural Areas

The Whatcom County Shoreline Master Program (SMP) informs the use, development, and management of shoreline areas throughout Whatcom County. The County seeks to achieve the goal through effective implementation of the SMP policies and regulations, by cooperating with other local, state, and federal agencies, tribes, non-profit organizations, and landowners, and by encouraging and facilitating voluntary actions that will improve shoreline ecological functions over time. As a DID Commissioner and landowner your participation is integral to the success of this important program.

The SMP also guides implementation of needed restoration measures. Those restoration opportunities associated with areas where agriculture is a significant land use have been taken from the SMP and set forth below. This information should help you identify what mitigating measures would be most valuable to your community. This information is organized by Watershed Management Unit “WMU”. The following map and table help you identify which WMU(s) your DID or property is located.



Location of Special Districts within Watershed Management Units (WMUs)	
District	WMU(s)
Consolidated Drainage Improvement District No 1	Lynden North
Consolidated Drainage Improvement District No 20	Lynden North
Consolidated Drainage Improvement District No 21	Lower Mainstem Nooksack
Consolidated Drainage Improvement District No 31	Sumas River
Butler Drainage Improvement District	Birch Bay
Drainage Improvement District No 2	Lower Mainstem Nooksack
Drainage Improvement District No 3	Ten Mile
Drainage Improvement District No 5	Lower Mainstem Nooksack
Drainage Improvement District No 6	Lower Mainstem Nooksack
Drainage Improvement District No 7	Drayton Harbor
Drainage Improvement District No 15	Sumas River
Drainage Improvement District No 17	Drayton Harbor
Drainage Improvement District No 30	Ten Mile
Drainage Improvement District No 30A	Silver/Nooksack Channel & Delta
Diking District No 1	Lummi Bay
Diking District No 4	Lower Mainstem Nooksack
Macaulay Creek FCZD	Upper Mainstem Nooksack

A summary of process-based restoration priorities in watersheds where agriculture is a significant land use is set forth in the table below.

Summary of Process-based Restoration Priorities (Ag Related)		
Process/ Mechanism	Restoration Measure	Desired Ecosystem Response
Freshwater Rivers, Streams and Lakes		
Hydrology		
Infiltration/ Recharge	Plug ditches and remove drain tiles to restore wetland hydrology in lowland areas Remove bank hardening to allow channel migration and increase stream length and sinuosity	Improved infiltration and groundwater recharge Adequate instream flows
Surface Water Storage	Disconnect roadside ditches from natural drainage network Restore depressional wetlands in headwater areas	Reduced streambank erosion Reduced scour and stream incision
Runoff and Peak Flows	Provide setback levees/dikes to improve floodplain and riverine wetland connectivity Breach/remove dikes to restore and reconnect tidal channels	Improved channel morphology and instream habitat Improved habitat for wetland-dependant wetland-associated wildlife species
Groundwater Discharge	Manage groundwater withdrawals	Improved access to rearing habitat Improved habitat complexity
Sediment		
Sediment Delivery and Storage	Restore wetlands between sediment source and downstream aquatic resources Implement best management practices in agricultural areas and developed areas to minimize erosion Restore stream buffers in agricultural areas and on forest lands to reduce bank erosion	Reduced fine sediment loads, turbidity, and embeddedness Improved channel morphology and instream habitat complexity Reduced egg, fry, and alevin mortality Reduced phosphorus transport Diversification of stream biota
Water Quality		
Nitrogen Delivery and Removal	Restore and protect riparian vegetation in groundwater discharge areas Restore and protect riparian vegetation along headwater streams Restore and protect riparian vegetation in areas with shallow alluvium or hydric outwash conditions Restore and enhance depressional wetlands and lakes downstream of urban and agricultural lands Remove or plug ditches to increase residence time Remove dikes and/or install setback levees to restore overbank flow, hydraulic connectivity and hyporheic functions	Denitrification Fewer shellfish closures Reduced algal blooms Improved nutrient cycling Improved invertebrate richness

Phosphorus Delivery and Removal	Restore depressional wetlands on upland terraces and in erosion-prone areas Restore riparian buffers and valley bottom vegetation Re-establish stream meanders in areas of straight line hydrography	Reduced Biological Oxygen Demand (BOD) Increased Dissolved Oxygen (DO) Reduced algal blooms
Pathogen Delivery and Removal	Infiltrate surface runoff Restore depressional wetlands upstream of estuaries Use infiltration trenches with sand filters Reconnect and re-establish/rehabilitate floodplain wetlands to allow sediment removal Remove or plug ditches to increase residence time Restore overbank flooding in important areas above aquatic resource of concern; focus on areas that have riverine depressional wetlands (mineral soils)	Reduced shellfish closures Reduced algal blooms Improved nutrient cycling Improved invertebrate richness
Organic Materials		
LWD Recruitment	Re-establish conifer stands and fast-growing hardwood species adjacent to stream Eliminate structures that minimize channel migration to increase recruitment potential via channel migration or avulsion Restore forest cover on mass wasting risk areas with the potential to deliver wood to streams	Improved channel complexity and habitat diversity Improved channel stability Lower stream temperatures Increased side channel formation Increased detritus inputs Improved bank stability
Heat/Light		
Canopy Cover	Restore canopy cover in riparian and nearshore areas	Lower stream temperatures Increased bank cover

Salmon recovery priorities are also woven into the SMP. Generally speaking, for the lowland tributaries of the mainstem Nooksack and independent tributaries to the Fraser River and the Strait of Georgia, priorities are to: restore riparian areas, restore water quality conditions, and reconnect isolated habitats. These priorities are summarized in the table below.

Nooksack Basin habitat restoration priorities by watershed area, WRIA 1 Salmonid Recovery Plan (Source: Nooksack Natural Resources et al. 2000) (Ag Related)	
Area	Restoration Priorities
Lower South Fork	- Acquisition of priority habitats - Large-scale LWD placement - Restoration of channel migration area - Riparian restoration to improve wood delivery - Riparian restoration to improve riparian shading - Set back infrastructure from the channel - Wetland restoration to improve baseflow, temperature maintenance
South Fork tributaries	- Riparian restoration to improve wood delivery to the channel - Riparian restoration to improve channel shading
Upper Mainstem	- Riparian and floodplain habitat acquisition - Riparian restoration for shading in the Upper Mainstem Area - Riparian restoration for wood recruitment in the Upper Mainstem Area - Levee setback and removal of bank protection along the Upper Mainstem Nooksack - LWD placement
Lower Mainstem	- Early action projects that integrate floodplain management with habitat recovery: Bertrand Creek area; Whiskey-Schneider Creek area - Implementation of Best Management Practices on urban and agricultural lands - Restore mainstem channel complexity - Systematically integrate flood planning with habitat recovery
Mainstem tributaries	- Restoration of tributary slough habitat to provide flood refuge for fry and overwintering juveniles in the lower mainstem - Small-scale riparian restoration through CREP, voluntary stewardship, or community-based programs that do not compete with early Chinook salmon projects - Establish and manage for instream flows through Watershed Management Project - Implement best management practices to maintain water quality for downstream habitats - Restore fish passage using funding sources specifically targeted for fish passage improvements

South Fork Nooksack WMU The South Fork (SF) Nooksack WMU lies in southeastern Whatcom and northeastern Skagit counties. The following specific restoration opportunities have been identified for the SF WMU:

- Install instream LWD at key areas to improve channel stability, habitat diversity (e.g., pool formation, etc.), temperature, and habitat quantity for adult holding and spawning in the lower South Fork. See the Acme-Saxon In-stream Assessment (Maudlin et al. 2002) and the Acme to Confluence Assessment (Nooksack Natural Resources, in prep.), which identifies specific areas for in-stream wood placement.
- Remove or set back infrastructure that is constraining channel migration in the lower South Fork. Examples include pipeline crossings (natural gas pipeline and City of Bellingham water pipeline), a railroad, State Route 9, Mosquito Lake Road, and Saxon Road.
- Enhance riparian areas along stream corridors (mainstem and tributaries) dominated by deciduous trees through planting conifers to improve LWD wood delivery to the channel and mitigate temperature impacts.
- Restore former and/or degraded wetlands on the floodplain (e.g., Rothenbuhler Slough, Foxglove wetland complex near Acme, and the Landingstrip Creek area) and in the vicinity of Black Slough. Also, restore drainage ditches on the floodplain to enhance wetland functioning.
- Manage forest roads to mitigate sediment generated from road failures.
- Acquire lands in the upper South Fork floodplain from timber interests.
- Restore side channels and other off-channel habitat and enhance riparian areas on Hutchinson Creek to aid in long-term sediment storage (through LWD recruitment and pool creation).

Upper Mainstem Nooksack River WMU The Upper Mainstem Nooksack WMU stretches from the towns of Everson and Nooksack upstream to the confluence of the Middle Fork and North Fork. The following specific restoration opportunities have been identified for this WMU:

- Protect deltaic character of the Anderson Creek mouth to maintain complex instream and riparian habitats.
- Restore wetlands upstream of the Anderson Creek mouth in Reaches 3, 4, and 5, to provide areas for sediment storage and nutrient cycling.
- Repair armored banks and depauperate riparian zones along the mainstem, especially in the low gradient, unconfined reaches.
- Introduce key pieces of LWD to stabilize what are generally loose aggregates of LWD deposits within the mainstem to jumpstart stabilization/restoration of stream morphology by creating permanent islands, increasing instream sediment storage capacity, and providing habitat complexity.
- Enhance riparian cover in areas of bank instability such as SMP inventory Reach 19 upstream of the Mount Baker Highway crossing and Reach 20 upstream of Deming.
- Reconnect Smith Creek to the Nooksack floodplain and protect existing riparian forest of the Nooksack floodplain near the confluence of Smith Creek.
- Protect groundwater discharge areas on the right bank upstream of Everson to ensure cool water supply to the mainstem.

Lower Mainstem Nooksack River WMU The Lower Mainstem stretches from the confluence with Tenmile Creek upstream to the towns of Everson and Nooksack. Conditions within the WMU are affected by the area's contributing basin, which includes the Forks, the Upper Mainstem, and Lynden North WMU, as well as the Tenmile WMU to the south and downstream. Wiser and Fountain Lakes lie to the south of the river. While Wiser Lake drains via Cougar Creek to the Nooksack just above the Tenmile Creek confluence, Fountain Lake drains to Scott Ditch, which runs from Everson to its confluence with the river south of Lynden. Wetland complexes are

associated with both lakes and Cougar Creek, but most existing wetlands occur lower in the WMU and are associated with Schneider Creek and/or the Nooksack floodplain.

Agriculture, including dairies, row crops, and till agriculture, dominates the landscape along the lower mainstem. Forest cover is limited and occurs in isolated patches associated with non-agricultural land uses. The towns of Everson and Lynden mark the upper and lower extent of the WMU, and residential land use extends between the two in the southern portion of the WMU, including substantial development surrounding Wiser Lake.

The Lower Mainstem WMU provides important habitat for salmonids. Additionally, the WMU includes mapped bald eagle habitat, trumpeter swan habitat, shorebird foraging habitat and concentrations of wintering waterfowl at Wiser Lake, band-tailed pigeon habitat along the upper reaches of an unnamed tributary west of Willeys Lake, and sandhill crane foraging and roosting habitat in the agricultural lands around an unnamed tributary to the north of Lower Mainstem (WCPDS 2005). There is also a sensitive sedge species (bristly sedge) along the shoreline of Wiser Lake west of the Guide Meridian.

Degraded and Impaired Areas

Degraded and impaired areas occur throughout the entire WMU. One apparent alteration is the widespread conversion of forest land to agricultural land, which occurred decades ago. Forest cover within the WMU is a fraction of historic conditions. In addition, a large percentage of wetlands have been converted to agricultural use or otherwise altered. The Scott Ditch area, upper Schneider Creek drainage, and areas immediately upstream and downstream of Wiser Lake have experienced the most pronounced wetland losses.

The upper reaches of Cougar Creek and Scott Ditch have been straightened, which alters hyporheic zones and, in combination with agricultural use, urbanization, road crossings, and impervious area, contributes to sediment and nutrient loading within the WMU. This WMU exhibits higher levels of impervious area than most areas in the County, ranging from 3 to 10 percent in the area from Wiser Lake east to Nooksack. Areas of high impervious surface also occur in the southwest corner of the WMU (near the north edge of Ferndale) and in the Schneider Creek drainage near Tatlow and Harksell roads. These impervious areas tend to coincide with permeable deposits indicating increased potential for impaired infiltration/recharge and discharge processes.

Surface and groundwater withdrawals, the interruption of surface and groundwater flows, and loss of surface water storage areas, have affected baseflows within the WMU. Extensive diking along the mainstem of the river has also increased sediment transport and deposition, altering channel morphology compared to historic conditions.

The loss of storage and infiltration/recharge capacity has not only altered peak runoff patterns but also reduced groundwater quantity and limits base flow. Effects on baseflow are also being caused by water consumption. Based on 1997 water rights data, potential consumption of groundwater and surface water in the Lower Mainstem tributary drainages (Scott Ditch, Wiser Lake/Cougar Creek, and Schneider Creek) amounts to approximately 99 cfs, the majority of which is groundwater. This figure is dwarfed by water rights on the Nooksack River, which is estimated at 697 cfs (all water rights converted to cfs for consistency), most of which is surface water. These estimates suggest that consumption is large enough to influence both surface and groundwater hydrology.

Riparian cover is reduced from historic conditions as well, both on the mainstem and the tributaries. Off-channel rearing habitat has been altered and mostly lost. All of these alterations adversely affect water quality and quantity throughout the WMU.

Levees and riprap line the riverbanks to contain peak events with recurrence intervals up to approximately 5 five years. Increased sediment supply from upstream sources has likely increased the rate and amount of sediment deposition along the lower mainstem (Smith 2002). The existing levees/armoring limit the delivery of surface water to potential storage areas and contribute to channel straightening, which increases gradient, decreases flowpath length, and ultimately reduces the potential for peak flow attenuation. The loss of floodplain connectivity and wetland storage also reduces habitat availability and habitat complexity for fish and other aquatic organisms.

The WRIA 1 SRP (Nooksack Natural Resources et al. 2005) reports several responses that can be linked to the hydrology impairments noted above: The length of the lower mainstem channel between RMs 15 and 19 decreased by 35 percent between ~1800 and 1938 due to bank modifications/armoring. Similarly, floodplain area decreased from 33 square miles to 2 square miles below Everson.

Smith (2002) reports reduced baseflow responses to hydrologic alterations. Wiser Lake and most of the tributary drainages along this section of the Nooksack River that are in separate WMUs have partial or full water rights allocation closures. Seepage runs performed by USU (2001) report that on the day sampled, the Nooksack River was a losing reach upstream of the mouth of Kamm Slough.

Increased frequency and duration of peak flows in the Lower Mainstem WMU are predicted based on conditions within the contributing area (which includes the Upper Mainstem and Forks WMUs).

Degraded and Impaired Areas

Much of the land area in the Lower Nooksack Mainstem WMU lies within the Nooksack floodplain, which is an important area for most processes. Restoring drained, degraded, and/or ditched wetlands within the mainstem floodplain including in the Scott Ditch and lower Schneider Creek drainages is one of the key opportunities that should be investigated. Wetland restoration in the Cougar Creek/Wiser Lake corridor and in the Upper Schneider Creek drainage could also help improve water quality and instream flows. Restoration efforts in the area would need to be coordinated with ongoing agricultural uses and existing and planned flood management activities.

Restoration Opportunities

The following specific restoration opportunities have been identified for this WMU:

- Enhance riparian cover in areas of high bank instability such as SMP inventory Reach 15 downstream of Everson.
- Integrate floodplain management with habitat recovery, especially in the Schneider Creek area.
- Implement Best Management Practices on urban and agricultural lands to prevent water quality and habitat degradation.
- Restore tributary slough habitat by reconnecting channels to provide flood refuge for fry and overwintering juveniles in the lower mainstem.
- Restore riparian forest cover on the mainstem and tributaries through CREP, voluntary stewardship, or other community-based programs.

- Establish and manage for instream flows through the WRIA 1 Watershed Management Project.

Lynden North WMU The Lynden North WMU encompasses the area between the Drayton Harbor and Sumas WMUs and drains to the lower mainstem Nooksack River. Almost half of the watershed lies in Canada. Of the WMU lying within Whatcom County, almost three fourths of that area (40 percent of the watershed) is in agricultural use. Land use in the Canadian portion of the WMU is a mixture of urban and agricultural uses.

The Lynden WMU contains the right bank of the lower mainstem Nooksack River, and the following tributaries: Fishtrap Creek, Bertrand Creek, and Kamm Slough. Judson Lake lies on the Canadian border to the east of Fishtrap Creek. The middle portion of Fishtrap Creek flows through the City of Lynden, where most urban development in the drainage is concentrated. Numerous wetlands are associated with the Bertrand Creek headwaters, and riparian wetlands remain along lower Bertrand Creek and its tributaries. Wetlands are also prevalent in the Kamm Slough headwaters and at the confluence of its two primary headwater tributaries.

Streams in the Lynden North WMU provide important habitat for salmonids. In addition, Bertrand Creek contains a narrow band of high quality riparian habitat (as defined by the WDFW PHS database) just above the confluence with the Nooksack River and in portions of the middle and upper reaches. Fishtrap Creek also contains bald eagle habitat.

Landowners in the Bertrand Creek watershed have established a watershed improvement district (WID) and are implementing a comprehensive irrigation district management plan (CIDMP) to improve water quantity, water quality, and aquatic habitat conditions throughout the watershed (EES 2004).

Degraded Areas and Impairments

Important infiltration/recharge and water storage areas have been altered throughout the Lynden North WMU. The City of Lynden is located directly over an area with high infiltration/recharge potential, and extensive wetlands in the Fishtrap Creek and Kamm Slough drainages have been filled or drained. These hydrologic alterations effectively reappportion precipitation from baseflow to surface runoff. This is particularly true in the area north of Lynden where there are numerous straight-lined channels. Many wetlands are still present in the Bertrand Creek drainage, although large areas of wetland have been drained/ditched or degraded in the upper drainage near the Beaver Ponds.

Within the Nooksack River floodplain, lower Bertrand Creek and nearby Fishtrap Creek are leveed for flood control purposes. The levees disconnect the streams from their floodplains, decreasing surface water storage during peak runoff events, promoting channel incision in the erosion-prone floodplain, and restricting lateral channel migration. Channelization is severe along mainstem tributaries. Such conditions typically limit storage potential both in the channel and in the associated riparian and hyporheic zones, and increase transport by decreasing channel roughness and shortening stream length.

Water withdrawals are also a major issue in the Lynden North WMU and contribute to reduced streamflow during the summer low period. Most water is consumed during summer months for agricultural purposes. EES (2004) estimates that between 8,400 and 10,550 acre-feet of water is consumed annually

for agricultural purposes in the Bertrand drainage and could reach as much as 16,800 acre-feet during dry years. Ecology has closed all three major drainages to additional water rights allocations, and both Bertrand and Fishtrap Creeks are currently failing to meet legally established flow minimums (Blake and Peterson 2004). Also, anecdotal evidence cited by Sinclair (2005) contends that Judson Lake currently dries up during the summer months as a result of a low water table.

The backsides of levees bordering the Nooksack River are prone to surface erosion, and lack of forest cover likely contributes to increased sediment supply from these areas. Cultivated lands, which are extensive throughout the WMU, may be another source of increased sediment inputs. High road densities and urbanization near Lynden increase the potential for sediment transport to aquatic resources via ditches and storm sewers. Rapid build-out in the City of Lynden and its UGA may be contributing to increased fine sediment in Fishtrap Creek.

Areas important for nutrient uptake, storage, and cycling have been extensively impaired throughout this WMU. Stream channelization, development adjacent to the Nooksack tributaries, and construction of levees are indicators that hyporheic functions are impaired. Source areas for fecal matter and associated pathogens are also widespread in this WMU. A large number of dairies exist throughout the northern part of the WMU and in Kamm Slough. Septic systems occur in high densities in the lower Bertrand Creek drainage to the west of the City of Lynden.

High fecal coliform levels are a primary concern throughout the Lynden North WMU. Bertrand Creek has an established TMDL for fecal coliform in the lower drainage, and certain reaches are listed as impaired for fecal coliform, dissolved oxygen, and nitrogen (Ecology 2004). Bertrand Creek is also listed as an area of concern for dissolved oxygen and nitrogen (EES 2004; Ecology 2004). Recent TMDL monitoring results show that Bertrand Creek exceeded the TMDL geometric mean and 90th percentile standards for fecal coliform and the standard for dissolved oxygen in 2004-5 (NWIC 2005).

In Fishtrap Creek, water quality impairment occurs mostly upstream of the City of Lynden. Particular sites include Double Ditch (east and west) and the ditches along Benson Road, Bender Road, Depot Road, and Assink Road. This is consistent with water quality data that suggest the largest fecal coliform contributions appear to occur upstream of Pangborn Road and between Bender Road and Lynden's Main Street (USU 2001; NWIC 2005). TMDL monitoring in 2004-5 shows that Fishtrap Creek failed to meet established standards for 90th percentile and median fecal coliform concentrations (NWIC 2005). Fishtrap Creek also violated standards for dissolved oxygen in the most recent monitoring (NWIC 2005).

Kamm Slough also has an established TMDL for fecal coliform and is listed as impaired for dissolved oxygen and pH throughout its entire drainage (Ecology 2004). TMDL monitoring in 2004-5 show that Kamm Creek exceeded 90th percentile and geomean targets for fecal coliform and also violated the dissolved oxygen standard during the winter months.

NWIC (2005) also reports general trends this decade in relative fecal coliform loading in the Nooksack system. The relative contribution from Fishtrap Creek and Kamm Slough is decreasing, while relative fecal coliform loading in Bertrand Creek is increasing. The likely cause of such a trend is improved management in Fishtrap Creek and Kamm Slough.

There is also evidence of groundwater contamination in this WMU. The WRIA 1 groundwater quality study identifies the Lynden North WMU as having some of the highest nitrate concentrations in the County, exceeding EPA limits for annual maximum concentration in every year during the 1990s (USU 2002). USU (2002) identifies the Judson Lake and Bertrand Creek drainages as also having particularly high nitrate concentrations in groundwater.

USU (2002) also identifies pesticide contamination in groundwater. Consequently, USU (2002) identified Bertrand and Fishtrap Creeks as the top priority in WRIA 1 for managing groundwater quality.

The ability of many streams in this WMU to recruit LWD is low because of the lack of intact riparian vegetation and straight line hydrography. Straight-lined channels are evident in the Kamm and Fishtrap Creek drainages, where agricultural land uses typically extend to streambanks leaving very little riparian vegetation. Areas with at least limited LWD recruitment potential occur on the mainstem Fishtrap Creek in and upstream of the City of Lynden, although riparian areas there are somewhat disturbed. The right bank of the Nooksack River has little to no LWD recruitment potential due to the proximity of agricultural fields and lack of channel migration potential. There are significant patches of forest in the Bertrand drainage, and recruitment potential along the mainstem Bertrand Creek remains functional. Many streams in the Lynden North WMU also lack instream habitat complexity. As an example, lower Bertrand Creek, the upper West Branch, and upper McClellan Creek generally lack pool habitats (EES 2004).

Areas lacking adequate canopy cover in the Lynden North WMU are extensive (Coe 2001). Bertrand Creek and its tributaries have only one segment with a greater than 70 percent canopy cover. Canopy cover in Fishtrap Creek is somewhat better; segments on the mainstem near the mouth, in the City of Lynden, and upstream of Lynden have at least 70 percent canopy cover. However, Kamm Creek and Fishtrap Creek tributaries have very low canopy cover. The lack of adequate canopy cover (shade) contributes to increased stream temperatures in lower Bertrand Creek, lower Fishtrap Creek (at Flynn Road), portions of Kamm Slough, and possibly other locations in the watershed.

Restoration Potential

The Nooksack River floodplain is a very important area for all key processes. It is also highly impaired and therefore ripe with restoration potential (**Table 8**). Actions should focus on reconnecting floodplain wetlands to the main channel and enhancing riparian cover. Restoration efforts in this area need to be carefully coordinated with the agricultural community and with the City of Lynden to ensure success and minimize conflicts with existing land uses.

Bertrand Creek is the least degraded of the three major drainages, yet restoring riparian areas and wetlands could contribute significantly to improved ecological function. There is potential to improve water quality and provide additional sediment storage in the upper Bertrand drainage by strategically restoring wetlands and riparian areas downstream of existing sediment and nutrient sources (often dairies). Protecting wetlands in the Boundary Upland and preserving areas of alluvial and outwash deposits along the Nooksack Valley are priorities for baseflow maintenance during summer low flow periods. Existing high quality riparian buffers should also be protected.

Wetlands could also be restored in the middle Fishtrap drainage where extensive peat deposits have been ditched and drained. Reclaiming these areas as wetland

could help to achieve instream flow and water quality goals for this watershed. In addition, directing future development around the City of Lynden toward areas that do not have high infiltration capacity would minimize future alteration of surface and groundwater flows.

The majority of the riparian corridors in this WMU, with the exception of the headwaters of Bertrand Creek and portions of Middle Bertrand Creek and the Beaver Ponds area, would benefit from improved riparian structure and cover. Restoring aquatic resources and riparian areas in the Lynden North WMU will promote full use of available salmonid spawning and rearing habitat, which is a primary goal for Whatcom County.

Restoration Opportunities

The shoreline inventory and the Bertrand Creek WID CIDMP (EES 2004) identify numerous restoration opportunities and needs for portions of the Lynden North WMU. Successful implementation of the CIDMP can improve watershed conditions by leading to higher streamflows during low-flow periods, better prospects for recovery of listed species, and cleaner water, and is therefore a key element of the overall restoration strategy for this WMU. Other restoration opportunities for this WMU include¹ :

- Improving fish passage at specific locations identified by Whatcom County, including the West Branch of Bertrand Creek and McClellan Creek, the tide gate on Duffner Ditch, on Fishtrap Creek in the City of Lynden, and other fish passage-limiting culverts throughout the watershed. Modify existing conditions on the West Branch and McClellan Creek to enable passage over the full range of streamflows.
- Reconnecting floodplain wetlands in lower Bertrand Creek (SMP inventory reaches 1-4) to the creek and planting with native trees and shrubs to enhance habitat value for terrestrial and aquatic wildlife.
- Restoring drained/ditched wetlands on peat deposits to provide additional water storage capacity.
- Implementing Best Management Practices on urban and agricultural lands to prevent nutrients, pathogens, and sediments from reaching streams and degrading water quality and habitat.
- Programmatically evaluating the costs and benefits of upgrading culverts (to improve fish passage) on agricultural lands on a watershed-wide basis.
- Re-establishing riparian buffers along the natural and artificial watercourses to provide habitat for salmon and other fish and wildlife, improve water quality, control erosion, provide shade, and filter/retain sediment, and nutrients.
- Directing development away from important infiltration areas (permeable deposits) and implement Best Management Practices (including stormwater retrofitting) to prevent future impacts to infiltration/recharge and groundwater discharge processes.
- Restoring riparian cover along Fishtrap Creek in conjunction with floodplain restoration in Reach 1. Restore riparian areas upstream to improve water quality function in areas correlated with increased loading, such as Reaches 7 and 8 and at tributary junctions. Restore channelized sections to a more natural morphology in Reaches 1 and 6.
- Improving canopy cover by planting conifers and fast-growing deciduous species along stream banks, especially in the lower reaches (Reach 1 through 4) of Bertrand Creek.
- Moving existing levees on the Nooksack, lower Bertrand, and lower Fishtrap approximately landward of their current location to provide

¹ Some of these are derived directly from the Bertrand Creek CIDMP (EES 2004).

- more reliable flood protection for downstream areas and allow for natural meandering through the low gradient floodplain. Levee setback would increase availability and complexity of riffles, pools, and in-channel structure and decrease the potential for levee breaks and harmful flooding.
- Installing large logs with intact rootwads below the ordinary high water mark (OHWM) to create low-velocity zones and cover for juvenile salmonids. Create densely vegetated mid-slope benches to reduce localized erosion and provide low-velocity flood refuge for salmonids over a range of flows.
- Placing slash, logs, and trees on banks and gravel bars and in the stream or river channel for easy recruitment, or key pieces placed in the channel to catch and collect floating debris.
- Continuing to protect water quality by supporting the fecal coliform TMDL clean up plan elements related to dairy waste management, municipal sewage treatment, and rural residential septic waste.

Tenmile Creek WMU The Tenmile Creek WMU drains 35 square miles in the southern portion of the lower Nooksack basin bordering Ferndale. Shorelines of the state within this WMU include the lower 7.4 miles of Tenmile Creek and Fazon Lake. In addition, the Tenmile WMU includes two major tributaries: Fourmile Creek and Deer Creek, and several small lakes. Barrett Lake is a former artificial impoundment of Tenmile Creek that now consists of a stream/wetland complex. Deer Creek, Tenmile Creek, and their tributaries have associated riparian wetlands along much of their length, and Fazon Lake is surrounded by a large wetland complex. Non-riparian wetlands are also common throughout the WMU, but the Fourmile drainage contains fewer existing wetlands than other areas.

Agriculture is the primary land use in the Tenmile WMU. This includes dairies and associated feed production and crop farms. Pasture and hay fields are distributed throughout the watershed and make up more than 50 percent of land in the WMU (WCD 1986). Less than 25 percent of the WMU remains forested. Most of the remaining forest is second- to later-growth mixed deciduous and conifers located in the southeastern corner of the WMU, in the Deer Creek headwaters.

This WMU provides important habitat for salmonids. Tenmile Creek supports fall run Chinook and coho salmon, and steelhead/rainbow and cutthroat trout, and is primarily used for rearing and migration (including holding). Fazon Lake has been documented as important habitat for waterfowl during the winter, spring, and fall (WDFW 2004).

Degraded Areas and Impairments

Existing and historic land uses have altered infiltration and recharge, nutrient storage/uptake, and sediment storage processes in the Tenmile WMU. Sediment and nutrient loading have increased from historic conditions due to loss of forest cover, urban development, road crossings, and till agriculture. The increased sediment loading along with decreased stream flows appears to have created opportunities for extensive colonization by reed canarygrass in stream channels and adjacent riparian zones. Periodic dredging of Tenmile Creek provides temporary relief from streambed aggradation and canarygrass infestation, but dredging disturbs and homogenizes habitat and does not provide a long-term, process-based solution to habitat problems. Reduced groundwater storage has also lowered baseflow in the WMU.

Throughout the WMU, streams have been straightened and ditched, and riparian cover has been reduced. Numerous wetlands have been drained,

particularly in the middle Tenmile drainage near the confluence with Fourmile Creek. Historically, streamside wetlands provided important salmonid rearing habitat and backwater habitat for myriad aquatic and terrestrial species, but channelization has limited these functions and reduced habitat heterogeneity.

The impairments to surface water storage, infiltration, and groundwater recharge and the lack of area for sediment storage and nutrient uptake directly affect water quality in the WMU. These impacts are exacerbated by the riparian-scale alterations, which lower hyporheic and riparian wetland function and decrease the stream length along which water quality functions can occur.

Tenmile and Fourmile Creeks are listed as areas of concern for water temperature (Ecology 2004), but Deer Creek is not on the 303(d) list for temperature. Listings were based on Joy (2000) data for Tenmile Creek and unpublished NSEA data on Fourmile Creek. The data show a higher incidence of temperature exceedances below Barrett Lake. Only one temperature sample on both Tenmile and Fourmile Creeks upstream of Barrett Lake exceeded Ecology's 303(d) temperature criteria.

Restoration Potential

In this WMU, restoration potential is concentrated in the lower Deer, middle Tenmile, and Fourmile Creek drainages (Table 9). These areas are important for most processes and are also highly altered. In addition, there are opportunities to improve riparian cover along all streams as canopy cover and LWD recruitment potential are generally below desired levels.

Fourmile Creek is perhaps the most altered drainage within the WMU. The mainstem is almost entirely channelized, and many of the associated wetlands, which contain organic soils important for nutrient storage and uptake, have been drained or filled. Hydrology of wetlands along the stream corridor (particularly upstream of the Guide Meridian) and depressional wetlands outside the riparian corridor could be restored to improve water storage capacity, flood desynchronization, and baseflow support.

The Fourmile Creek drainage also contains extensive areas for infiltration/recharge, water storage, and groundwater discharge, but many of these areas have been altered to support agricultural development and other land uses. Restoring forest cover and re-establishing degraded wetlands on permeable deposits within and outside the riparian corridor could improve baseflow, and water quality, and mitigate sediment delivery to streams. Low-order headwater streams are also important nutrient sinks, and water quality function may be enhanced by restoring riparian vegetation and streamside wetlands in these areas as well.

Because of the level of urbanization in the Fourmile and particularly Deer Creek drainages, there are fewer opportunities for restoring altered processes, but opportunities for site-specific functional improvements may be available.

Restoration Opportunities

Specific restoration opportunities for the Tenmile WMU include:

- Implement measures to control reed canarygrass infestations in Tenmile Creek including Barrett Lake.
- Implement measures to eradicate spotted knapweed (Reach 2) and tansy ragwort (Reaches 2 and 6) along Tenmile Creek.
- Restore former riparian wetlands along Fourmile Creek, including wetlands on organic deposits.
- Protect existing forest cover along the lakeshore of Fazon Lake. The existing buffer width ranges from approximately 150 feet on the south end

to more than 1,000 feet on the northwest shoreline.

- Plant conifers and fast-growing hardwoods throughout the riparian zones on lower Tenmile, Deer, and Fourmile creeks, as well as headwater tributaries where cover is lacking, to improve LWD recruitment potential.
- Increase stream sinuosity and floodplain connectivity along Fourmile and Deer Creeks.
- Implement Best Management Practices on urban and agricultural lands to prevent nutrients, pathogens, and sediments from reaching streams and degrading water quality and habitat.
- Protect the alluvial fan near the mouth of Tenmile Creek from encroachment or other disturbance.

Nooksack Delta/Silver Creek WMU

The Nooksack Delta/Silver Creek WMU stretches north from Bellingham Bay upstream to the Tenmile Creek confluence and west to include Tennant and Silver Creek drainages. Restoration opportunities for the Silver Nooksack Delta area include:

- Restore riverine-tidal blind channel network at Marietta Slough.
- Set back levees on left bank of the river between Slater Road and Ferndale to improve the rearing habitat and passage characteristics of the estuary.
- Restore instream habitat complexity of the mainstem channel.
- Prioritize and implement relevant recommendations from the Bellingham Bay Pilot Project.
- Restore degraded wetlands directly downslope of Ferndale.
- Redesign or remove tide gates to enhance and/or increase the extent of tidal influence and estuarine area. The potential for restoring estuarine and/or tidally influenced areas extends beyond the existing distributary channels into Reach 3 and Reach 4.
- Install LWD to improve channel roughness and habitat heterogeneity.
- Expand public land holdings to include Tennant Lake, the Nooksack River, and the associated floodplain and wetlands in between.

Drayton Harbor WMU

Drayton Harbor is a coastal watershed located in the northwest corner of the County, to the west of the lower mainstem Nooksack River and Bertrand Creek. Specific restoration opportunities in the Drayton Harbor WMU include:

- Restore wetlands and riparian areas associated with the California Creek through planting.
- Restore riparian vegetation along California Creek, focusing on Reaches 2, 5 and 8.
- Restore riparian vegetation along Reaches 5 and 7 of Dakota Creek.
- Protect existing forest cover, particularly conifer stands such as those found in Reach 8 of Dakota Creek, to ensure long-term LWD recruitment potential.
- Improve instream habitat conditions in Dakota and California Creeks by creating additional off-channel estuarine and tidal habitat in the lower reaches.
- Investigate and address the potential barrier at Loomis Trail Road between the stream (California Creek) and an associated wetland. Reconnect the wetland to improve hydrology, storage potential, and habitat access.
- Install LWD in both streams to rectify problems of low quality pool and riffle habitat. Reach 5 of California Creek appears to provide the best opportunity for combined channel realignment, off-channel habitat creation, riparian planting, and in-stream structure placement.
- Remove creosote pilings including soldier pile bulkheads at a degraded soldier pile bulkhead (scoured away on landward side) located northwest of Dakota Creek, and at creosote piles located near the Semiahmoo Spit marina (in the City of Blaine).

- Modify the California Creek causeway.
- Restore marine riparian vegetation in areas devoid of overhanging vegetation.
- Removing unnecessary bulkheads, and debris in intertidal areas.

Sumas River WMU The Sumas River WMU is part of the Fraser River basin. Although separated from the Nooksack River system by levees, the WMU includes a portion of the historic Nooksack floodplain. During flood events, the Nooksack River sometimes flows north into Canada via the Sumas River. Approximately one third of the total drainage area is in Canada. Within the WMU there are three distinct geologic areas; the Sumas Mountain area in the west, wherein land use is dominated by forest practices; the Sumas River valley and associated floodplain, and the lowland valley floor to the west, which is dominated by agricultural use, including dairies as well as row crops. Incorporated areas include Nooksack and Sumas.

This WMU includes extensive wetland including wetlands on organic deposits. Pangborn Lake occupies a scoured depression and is representative of a significant land area in the Johnson Creek sub-drainage in which organic wetlands historically formed.

Chinook, chum, and coho salmon, steelhead, bull trout, and sea-run cutthroat trout have been documented in the Sumas River. Sockeye salmon have been observed in the lower reaches. Major tributaries including Saar, Johnson, and Breckenridge Creeks also provide important salmonid habitat. Great blue herons, band-tailed pigeons, bald eagles, vau's swift, peregrine falcons, and trumpeter swans also occur in this WMU.

Degraded and Impaired Areas

The Sumas River valley floor has been altered by agricultural practices including ditching and draining of wetlands and streams, and loss of forest cover. Loss of historic wetlands is particularly evident along Johnson Creek, Sumas River, Bone Creek, and Saar Creek floodplains, and in the Pangborn Lake area.

Forest practices in the Sumas Mountain area have altered sediment transport and hydrologic processes in this area, but the degradation does not appear to be severe. Riparian corridors throughout the WMU are lacking in LWD and cover. Predominant riparian conditions include mowed grasses or shrubs to within 25 – 50 feet of the stream edge. The central portion of the WMU, the transitional foothills area, is not conducive to agriculture, and is characterized by mixed residential use. Ecological processes are relatively intact in this area and should be protected.

Water quality degradation is evident in several areas. The Sumas River has had elevated fecal coliform and low dissolved oxygen. Pangborn Creek, Clearbrook Creek, three reaches of Squaw creek, seven reaches of Johnson Creek, and Saar Creek also have been listed as impaired for fecal coliform levels (Ecology 2004). A TMDL was established in 2000 for fecal coliform and dissolved oxygen in the Johnson Creek drainage. A TMDL was also established in 1996 for chlorine, ammonia-nitrogen, and BOD in the Sumas River drainage. The Sumas River WMU has some of the highest nitrate concentrations in the County, exceeding EPA limits for annual maximum concentration in 8 of 11 years during the 1990s (USU 2002; Mitchell et al. 2005).

Restoration Potential

The mainstem Sumas River lies on the lowland outwash plain and processes

are severely impaired. Opportunities for restoration are extensive, including enhancing existing riparian wetland habitats that have a high potential for hyporheic function and nutrient cycling (Table 16). The same is true for Johnson Creek, which has good potential for wetland restoration. Protecting existing peat wetlands in Johnson Creek is critical for continued nitrogen transformation mechanisms.

The North Fork Johnson Creek and the headwaters of Saar Creek are two areas where many processes are relatively intact, and there are extant wetlands that support multiple processes. Since ecological functions are less degraded in these areas, they are good candidates for protection and conservation. Upper Johnson Creek also retains some ecological function, but process alteration is still extensive.

The transitional foothill area is an important management area that is not conducive to agriculture but supports residential and other development. This area contains lower-gradient streams that are relatively unaltered. Protection of important areas in this zone would minimize further degradation of the valley.

Restoration Opportunities

Opportunities for restoring this WMU include:

- Restoring riparian zones and riverine wetlands along lowlands streams to improve hyporheic function, riparian filtering, and chemical cycling functions.
- Protecting intact Sumas River tributaries in the Sumas Mountain foothills.

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Appendix B

Whatcom County

Drainage Improvement District #00

Drainage Management Plan



Drainage Improvement District #00

Whatcom Conservation District

Whatcom County Public Works

**with support from the
Centennial Clean Water Fund
under the authority of the
Washington State Department of Ecology**

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SECTION 1 -- DISTRICT OVERVIEW

Location:

Whatcom County Drainage Improvement District #00 (DID #00) is located within the Brown Creek watershed in northwest Whatcom County, south of the City of Blaine and northwest of the City of Ferndale (Figure 1).

Boundaries:

DID #00 jurisdictional boundaries are illustrated in Figure 2. The district is bordered by Brown Road on the west and other borders generally following parcel boundaries. Brown Creek is the northeast boundary. CDID #01 adjoins the district to the east.

Area:

DID #00 encompasses approximately 1,857 acres within its jurisdictional boundaries.

Significant Features:

DID #00 is located in an area of undulating pastures with significant natural wetlands. The water table is nearly at the surface in the winter. Tom Ditch and Cooper Creek, the two primary watercourses have perennial flows and are utilized by Coho Salmon and Cutthroat Trout. Spawning areas are outside the district boundaries. WDFW and WSDOT both have significant holdings in the district. Water from DID #00 is discharged into Brown in the northeast corner of the district. Brown Creek then discharges into Puget Sound approximately 2.5 miles further downstream.

Predominant Land Uses:

Crop farms and hobby farms are the predominant land use in DID #00. Approximately 1,000 acres are currently used for crop and pasture production in support of the dairy industry. Most of the district is zoned either Agricultural or Rural 1DU/10AC. Residential housing development is expected to expand in the future with a consequent increase in stormwater discharge to the district's watercourses.

Predominant Drainage Issues:

1. Beavers – Beavers dams cause most of the drainage related concerns in DID #00. The district and its landowners frequently need to modify or remove beaver dams and occasionally trap to reduce beaver populations. This is typically the only drainage management issue on stream reaches that have been re-vegetated.
2. Reed canarygrass – Grass growing in the channel bottom and on the streambanks impedes drainage and prevents natural sediment transport. Reaches of stream that have not been re-vegetated need periodic grass control treatment including herbicide applications, mowing and dredging.
3. Accumulated sediments – The change in land use from agriculture to rural residential has resulted in decreased sediment input into channels. Streambank re-vegetation projects have stabilized many unstable banks that have been a source of sediment in the past. Currently one reach of Cooper Creek east of Ham Rd is used for both crop production and pasture with some sediment probably still impacting the channel.

SECTION 2 -- MAPS AND WATERCOURSE CLASSIFICATIONS

Watercourse Classifications:

The classifications used in this drainage management plan are defined in the Drainage Management Guide for Whatcom County and *Informational Factsheet #18 Watercourse Classifications* attached to this plan. Figure 3 illustrates the watercourse classifications in DID #00. An 1887 U.S. Coast and Geodetic Survey Map (Figure 4), WDNR watercourse GIS layers, aerial photos and local residents were used to determine the extent of modified natural and constructed watercourses.

Natural Watercourses (Red): No natural watercourses exist in DID #00. Some channels retain natural features such as meanders but have been either cleared or dredged in the past. 0 feet

Modified Natural Watercourses (Yellow): Cooper Creek and Tom Ditch are both maintained district channels: 23,538 feet. DID #00 maintains 11,150 feet of modified watercourse.

Constructed Watercourses (Green): Numerous field ditches exist in farmed areas. These ditches are typically short and terminate in either Cooper Creek or Tom Ditch: 21,343 feet. DID #00 maintains 1,000 feet of constructed watercourse. The remaining constructed watercourses are maintained by individual landowners.



Cover Crop Impacted by Beaver Dam

SECTION 3 -- OTHER DRAINAGE INFRASTRUCTURE

Road Crossings - Eleven culverts and bridges (Figure 3) (Table 1) are known to exist in DID #00. None of these crossings are owned or maintained by DID #00; however, DID #00 is responsible for keeping crossings clear of debris and beaver dams. Five road culverts are owned and maintained by Whatcom County and two culverts at railroad crossings are owned and maintained by BNSF. The remaining crossings are owned and maintained by private landowners.

Fish Passage - Fish passage to and from the district waterways may be restricted by features of the drainage infrastructure, primarily culverts. Using Whatcom County's Fish Passage Barrier Inventory, no culverts in DID #00 have been identified as being a barrier to fish passage however several known culverts have not been assessed.

Floodgates and Tidegates – None exist in DID #00.

Sediment Traps - None exist in DID #00.

Other Infrastructure - Two leveler type “beaver deceivers” also exist in DID #00. One is located on Cooper Creek near its confluence with Brown Creek. This device was installed by DID #00 in 2004 and consists of a “box pipe” made of heavy gage steel set within the beaver dam. The other device is located on Tom Creek west of Brown Rd and was installed by a landowner.

Table 1 DID #00 DRAINAGE INFRASTRUCTURE INVENTORY

Type of Structure	Number	Culvert Shape	Culvert Material	Culvert Coating	Culvert Span/Dia	Culvert Rise	Culvert Length	Bridge Length	Stream Name	Data Source	Priority Index #
Culvert	370120	RND	CAL		1.5	1.5	11.9		Cooper Creek	DOT	none
Culvert	1280156	RND	CST		0.9	0.9	13.0		Tom Creek	DOT	none
Culvert	1285127	RND	SST		1.2	1.2	5.8		Tom Creek	DOT	none
Culvert	370263	RND	CST		1.5	1.5	12.5		Cooper Creek	DOT	none
Culvert	370264	RND	CST		2.0	1.7	13.4		Tom Creek	DOT	none
Culvert	933	RND	PCC	NON	1.0	1.0	32.0		Unnamed	County	none
Culvert	936	RND	PCC	NON	1.5	1.5	36.0		Unnamed	County	none
Culvert	1395	RND	PCC	NON	1.5	1.5	31.0		Unnamed	County	none
Bridge	Unk00-01	?	?	?	?	?	?	?	Tom Creek	none	none
Culvert	Unk00-02	?	?	?	?	?	?	?	Cooper Creek	none	none
Unknown	Unk00-03	?	?	?	?	?	?	?	Cooper Creek	none	none
Unknown	Unk00-04	?	?	?	?	?	?	?	Cooper Creek	none	none

SECTION 4 -- SIGNIFICANT NATURAL FEATURES

FISH:

General Fish Information - For the purpose of this Drainage Management Plan, the term “fish” includes all species of native cold-water fishes with the primary focus being Salmonids. Generally water temperatures are elevated in these watercourses and they have been colonized by exotic species of fish that prefer warm water habitats. Pumpkinseed, Crappie, Smallmouth Bass, and others, are year around residents in the lower reaches of these watercourses. Many of these warm water species are voracious predators and should be considered deleterious to salmonid productivity.

Modified Watercourses (Yellow) typically support reproducing populations of Coho salmon and Cutthroat trout. The reproducing populations of Cutthroat trout can be either anadromous or resident. Anadromous adult Coho and Cutthroat typically enter the lower reaches of the watercourse to begin their upstream migration to the spawning habitats in late fall. Spawning occurs in the upper reaches of the watercourse where suitable spawning substrate is present and accessible. Coho spawn in the

late fall and Cutthroat spawn in early spring. Coho adults die after spawning whereas Cutthroat can survive to spawn in successive years. Anadromous adult Cutthroat that survive spawning migrate out through the watercourse from mid to late spring. After hatching from gravel nests (redds), emerging juvenile Coho and Cutthroat will distribute themselves to suitable rearing habitats in the watercourse. Anadromous juvenile Coho and Cutthroat generally spend 18 to 22 months rearing in freshwater before migrating to the marine environment. Generally, juvenile Coho and Cutthroat are present in the accessible reaches of the watercourse throughout the year.

General Fish Habitat Information –

Modified Watercourses (yellow) typically include suitable spawning and rearing habitats for Coho salmon and Cutthroat trout.

- Spawning habitats typically occur in those reaches that have gradients between 1-3% and are fed by flowing water and a steady supply of suitable sediments. These reaches tend to be found at the junction between low gradient reaches and the steeper gradient headwater reaches of the system.
- Rearing habitats can be distributed throughout these watercourses but are primarily located where there is sufficient channel complexity, riparian canopy, water quality and invertebrate productivity (fish prey/forage).

Constructed Watercourses (green) are wholly manmade systems constructed to convey water from a local surface or subsurface area for the purpose of improving the soil conditions for agriculture. Typically these watercourses are seasonal and do not have the habitat characteristics or natural processes necessary to support the rearing and spawning requirements of native cold water fishes. However, under some circumstances fish may be present in Constructed Watercourses.

General Fish Distribution – Fish distribution information is from Northwest Indian Fisheries Commission Limiting Factors Analysis (LFA). Very limited fish survey data is available for the lowland reaches in this district. Some local anecdotal fish presence information is included.

Fish Habitat in DID #00 - Functioning riparian areas are lacking along much of the watercourses and large woody debris is non-existent. The result is little high quality Salmonid habitat and elevated water temperatures. The reach analysis in Section 5 provides more detailed habitat information and photos.

Fish Distribution in DID #00 – Cooper Creek has presumed presence of Coho and potential presence of Cutthroat, Chum and Steelhead.

Tom Ditch has known presence of Coho and Cutthroat and the potential presence of Steelhead and Chum. Coho have been observed spawning in the upper reaches of Tom Ditch outside of DID #00 boundaries. Figure 5 details fish presence in DID#00. Sampling of fish presence may be done prior to drainage maintenance work and will be documented and reported. Systematic evaluation of fish presence would be useful but is beyond the scope of this plan.

WETLANDS:

Figure 5 shows Whatcom County CAO wetlands in DID #00. Wetland rating and delineations are beyond the scope of this plan. However most of these wetlands would probably be rated as III or IV with some possibly rated as II where native trees have grown or have been planted. Many of the wetlands are isolated and would not likely be impacted by drainage maintenance work. Some farmland adjacent to maintained watercourses have Prior Converted Wetland status and will be impacted by drainage maintenance work.



Typical DID #00 Wetland

SECTION 5 -- MAINTAINED WATERCOURSE REACH ANALYSIS

Figure 3 indicates watercourse reaches historically maintained by DID #00. Legal Easements allow continued drainage maintenance on all watercourses labeled as DID #00 maintained watercourses on Figure 3. Maintained watercourses have been divided into relatively homogeneous reaches. In depth analysis of reach habitat conditions would be useful but is beyond the scope of this plan. Drainage maintenance information for each reach can be found in Section 6. General information about each reach follows:

REACH T1

Reach Description

Reach T1 begins at the confluence of Tom Ditch into Cooper Creek east of Brown Rd and ends at the first Tom Ditch tributary west of Brown Rd.

Reach Length

Reach T1 is approximately 2,600 feet in length.

Current Reach Habitat Conditions

The channel in Reach T1 has been modified and simplified via historic maintenance dredging activities. Significant piles of old dredge spoils parallel the channel. The channel width ranges from 10 feet to 18 feet. Large woody debris in the channel is absent. Silts and fines dominate the channel substrate. Suitable salmonid spawning substrate is absent. Elevated water temperatures would be expected during the summer due to the broad channel width and the absence of riparian cover.

Riparian Characteristics

The right and left bank of Reach T1 are dominated by Reed canarygrass with scattered areas of mature native shrubs. Native trees and shrubs were planted on both sides of the stream east of Ham Rd in the spring of 2006 and on the left bank only in the spring of 2007. Plant growth has been slow but native shrubs should replace Reed canarygrass as the dominant feature within two more years.

Fish Passage Barriers & Obstacles

- A privately owned footbridge near the east boundary of reach T1 is in need of repair but is located well above the ordinary high water mark and poses no threat to drainage or fish passage.
- The Brown Rd culvert was replaced in recent years and is not a barrier Site ID #370264.
- An improvised "beaver deceiver" exists near the west end of reach T1 and is maintained by the landowner. This device has not been assessed for fish passage.

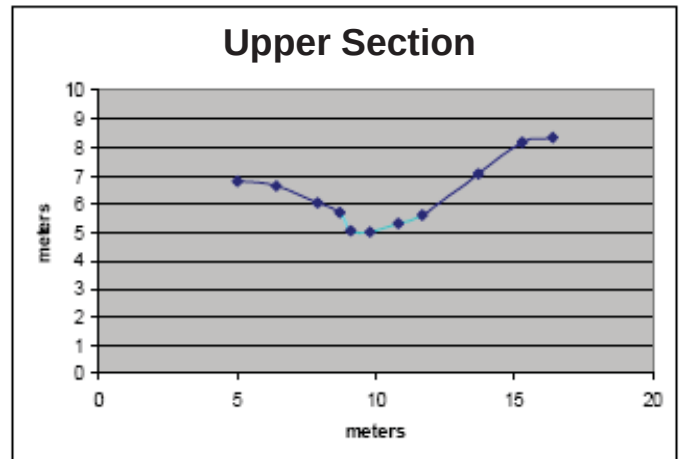
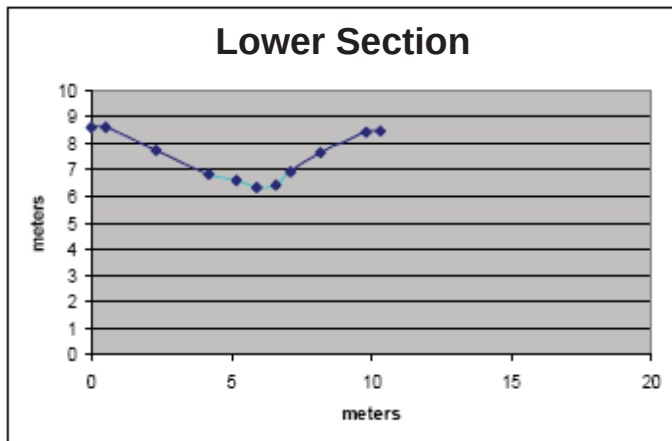
Spawning Habitat

Silts and fines dominate the channel substrate in Reach T1. Spawning habitat for salmonid species is not present.

Channel Cross Sections and Photos

Reach Fish Utilization

Salmonids have been observed upstream from Reach T1. Reach T1 is primarily a migration corridor and rearing habitat for Coho and Cutthroat. Habitat is limited by the absence of large woody debris in the channel and the absence of riparian habitat. Elevated water temperatures and low dissolved oxygen levels during the summer limit salmonid rearing opportunity.



(Reach T2, T3, T4, C1, C2, and C3 Descriptions Here)

SECTION 6 -- DRAINAGE MAINTENANCE SCHEDULE BY REACH

REACH T1

Reach Drainage Infrastructure

- DID #00 is responsible for maintaining Tom Ditch within this reach.
- WCPW maintains the Brown Rd culvert.
- An individual landowner maintains a footbridge east of Brown Rd.

Reach Drainage Maintenance Activities:

Maintenance Dredging

DID #00 plans to maintain 500 feet of this reach in the next 5 years.

Watercourse Vegetation Management

DID #00 does not plan to mow this reach in the next 5 years.

Culvert Maintenance and Replacement

The culvert located in this district is owned and maintained by WCPW. A privately owned beaver deceiver in the reach will be replaced by DID #00 in the next five years.

Aquatic Herbicides

DID #00 will continue to use herbicides annually in this reach to control Reed canarygrass until native trees and shrubs are large enough to provide adequate shade.

Bridge Maintenance and Replacement

DID #00 does not own or maintain bridges in this reach.

Beaver Dam Management

Beaver dams are a problem in this reach. Dams will be lowered or removed as needed.

Hand Maintenance

Vegetation and other obstructions will be removed by hand from this reach until adequate riparian vegetation is established.

(Reach T2, T3, T4, C1, C2, and C3 Maintenance Plans Here)

SECTION 7 -- ADOPTED BEST MANAGEMENT PRACTICES (BMPs)

DID #00 implements the following drainage practices using BMPs detailed in the listed BMP Factsheets:

Maintenance Dredging - Dredging is completed, as needed, by utilizing a hydraulically operated boom-type excavator operated from the top of bank. The excavator is typically equipped with a wide, flat-bottomed bucket with a lid that is designed to remove Reed canarygrass and accumulated sediments without allowing sediment laden water to spill back into the watercourse. Alternatively an excavator with a clamshell bucket is sometimes utilized to “pluck” obstructing clumps of Reed canarygrass from the channel without allowing sediment laden water to spill back into the channel. All dredged material is deposited landward of the ditch so that it will not return to the water and can later be moved back into the adjoining field or be hauled away.

- *BMP Factsheet #6 General Drainage Maintenance BMPs*
- *BMP Factsheet #7 Maintenance Dredging*
- *BMP Factsheet #14 Constructed Watercourse Maintenance*
- *BMP Factsheet #15 Fish Protection*
- *BMP Factsheet #16 Water Quality Protection Measures*

Beaver Dam Management – Beaver dams are the most common impediment to drainage in DID #00. When dams are of a sufficient size to impact property, they are typically removed by hand, often simultaneously with beaver trapping. If a dam is located in a natural or unnatural constriction point such as a culvert or area where the channel narrows, “beaver deceivers” or “flow levelers” may be utilized. Removal of large dams using a tracked excavator may be necessary in rare circumstances.

- *BMP Factsheet #6 General Drainage Maintenance BMPs*
- *BMP Factsheet #8 Beaver Dam Management*
- *BMP Factsheet #15 Fish Protection*
- *BMP Factsheet #16 Water Quality Protection Measures*

Watercourse Vegetation Management - Mechanical mowers (rotary or flail designs) are used to control vegetative material from the water line to the top of the bank.

- *BMP Factsheet #9 Watercourse Vegetation Management*

Aquatic Herbicides – Reed canarygrass growing in the channel bottom and on streambanks can be treated with an aquatic formula of glyphosate with less impact than mechanical dredging. Applications are done in late summer or early fall when the practice is most effective.

- *BMP Factsheet #10 Aquatic Herbicides and Watercourse Maintenance*

Culvert Maintenance and Replacement - Culverts must be maintained to ensure normal flow passes through the culvert consistent with its design specifications. This typically includes dredging of a ditch adjacent to culvert openings and occasional cleaning-out of the culvert interior. Cleaning is usually performed through the use of high-pressure water, mechanical dredging, or by hand. Repair or replacement is necessary when damage or normal deterioration occurs to the extent that prevents optimum water flow or an unsafe crossing situation. When replacement is necessary, bridges will be used when possible or new culverts will be designed using WDFW's no-slope design criteria.

- *BMP Factsheet #6 General Drainage Maintenance BMPs*
- *BMP Factsheet #7 Maintenance Dredging*
- *BMP Factsheet #11 Culvert Maintenance and Replacement*
- *BMP Factsheet #14 Constructed Watercourse Maintenance*
- *BMP Factsheet #15 Fish Protection*
- *BMP Factsheet #16 Water Quality Protection Measures*

Bridge Maintenance and Replacement - Bridges must be properly maintained in order to ensure normal flow under the bridge, while also continuing to provide equipment or foot access across a watercourse. Repair or replacement is necessary when incidental damage occurs to a bridge that prevents optimum water flow or results in an unsafe crossing situation. Repair or replacement activities typically occur above the high water line.

- *BMP Factsheet #12 Bridge Maintenance and Replacement*

Sediment Trap Maintenance – Sediment traps require regular removal of accumulated deposits to retain their capacity.

- *BMP Factsheet #6 General Drainage Maintenance BMPs*
- *BMP Factsheet #7 Maintenance Dredging*
- *BMP Factsheet #13 Sediment Traps*
- *BMP Factsheet #14 Constructed Watercourse Maintenance*
- *BMP Factsheet #15 Fish Protection*
- *BMP Factsheet #16 Water Quality Protection Measures*

Constructed Watercourse Maintenance – Landowners or DID #00 can maintain their constructed watercourses voluntarily using the BMPs listed in:

- *BMP Factsheet #14 Constructed Watercourse Maintenance.*

Hand Maintenance - Drainage will be maintained by hand in areas of DID #00 that have been planted with native trees and shrubs until the riparian area is established. Grass and other obstructions will be removed from the channel when necessary using hand tools.

- *BMP Factsheet #17 Hand Maintenance*

SECTION 8 -- HABITAT IMPROVEMENT OPPORTUNITIES

List of Potential Habitat Improvement Projects:

1. Enhance wetland swales by planting native tree and shrub buffers.
2. Enhance wetland swales by blocking connections to maintained drainage channels.
3. Enhance riparian zones by planting native tree and shrub buffers.
4. Assess habitat conditions in Tom Ditch from Reach T3 to the DID #00 boundary.
5. Distribute Informational Factsheets to DID #00 landowners to encourage land use practices that will better keep contaminants out of district watercourses.

Habitat Improvement Project 5 Year Goals:

1. Enhance Reach T1 by planting native tree and shrub buffers (approximately 500 feet of streambank).
2. Enhance Reach T2 by planting native tree and shrub buffers (approximately 1,500 feet of streambank).
3. Enhance Reach T3 by planting native tree and shrub buffers (approximately 350 feet of streambank).
4. Enhance Reach T4 by planting native tree and shrub buffers (approximately 750 feet of streambank).
5. Enhance Reach C2 by planting native tree and shrub buffers (approximately 450 feet of streambank).
6. Enhance Reach C3 by planting native tree and shrub buffers following Maintenance Dredging (approximately 1,800 feet of streambank).
7. Mail the following Informational Factsheets to DID #00 landowners:
 - *Informational Factsheet #19 Drainage Water Quality*
 - *Informational Factsheet #22 Farm Practices*

Figure 6 shows existing and planned habitat improvement projects in DID #00.

SECTION 9 -- MONITORING, REPORTING AND ADAPTIVE MANAGEMENT PLANS

Monitoring Plan: DID #00 adopts the following tracking form to monitor all of its activities.

Reporting: DID #00 will review and approve the completed Monitoring Form at their September annual meeting. A copy of the Monitoring Form with a few representative project photos will then be submitted to the WDFW Area Habitat Biologist.

Adaptive Management: DID #00 will review this Drainage Management plan at its annual meeting. Any changes in the plan should be clearly marked and submitted to WDFW for approval. Adaptive management measures may include:

1. Changes in Drainage Maintenance Schedule.
2. New or changed drainage maintenance BMPs.
3. Changes to Habitat Improvement Projects 5 year list.

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MONITORING & REPORTING FORM

DID #00 MONITORING & REPORTING FORM

Drainage Maintenance

Maintenance Practice	Date(s) Implemented	Reach	Watercourse feet impacted	BMP Implemented	BMP Implemented	BMP Implemented
Maintenance Dredging						
Watercourse Vegetation Management						
Culvert Maintenance and Replacement						
Bridge Maintenance and Replacement						
Aquatic Herbicide Applications						
Beaver Dam Management						
Sediment Trap Maintenance						
District Specific Maintenance Practices						

Monitoring Form continued on next page

Monitoring Form continued

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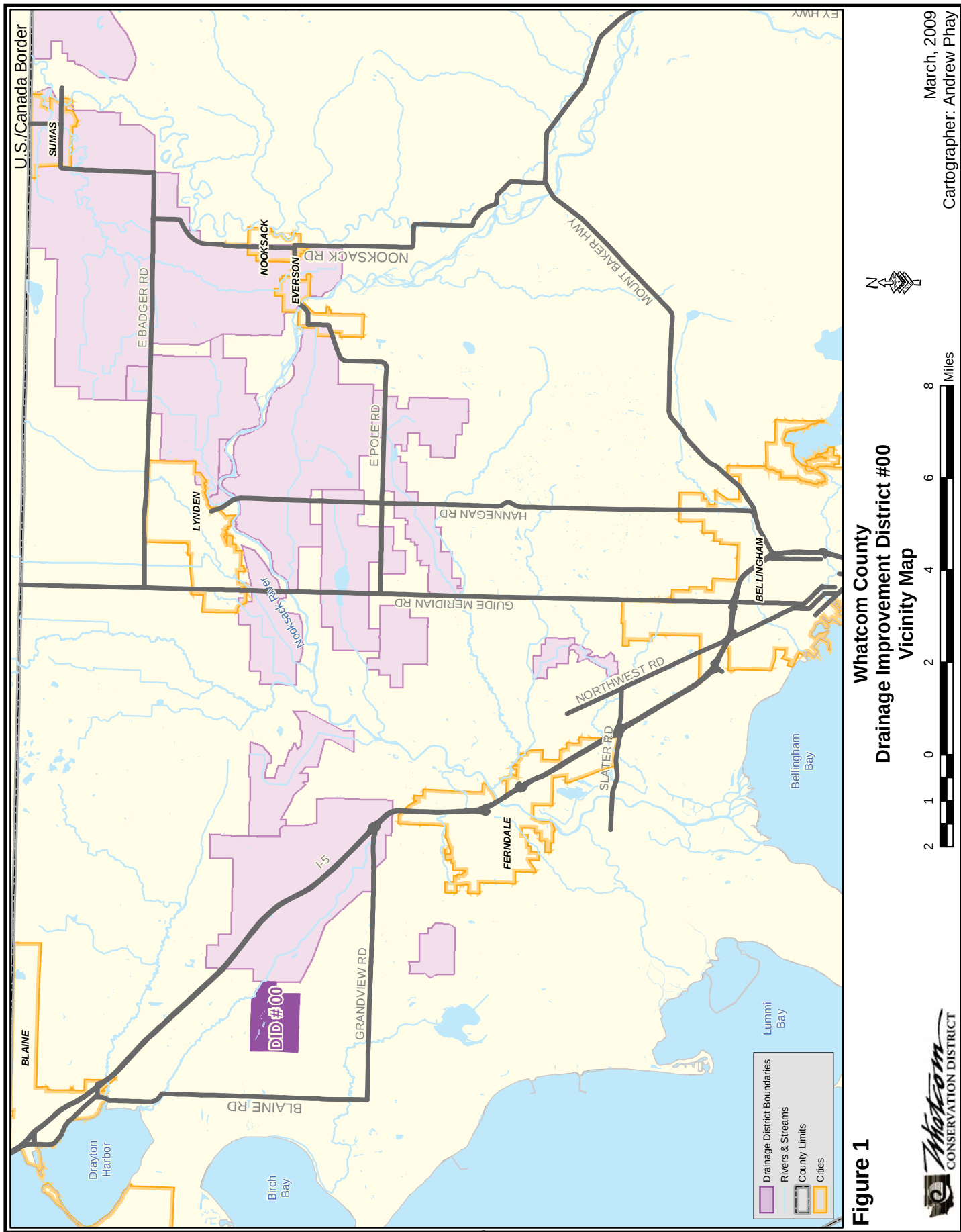
Monitoring Form continued on next page

Monitoring Form continued

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Completed plan will include Factsheets

- ***BMP Factsheet #6 General Drainage Maintenance BMPs***
- ***BMP Factsheet #7 Maintenance Dredging***
- ***BMP Factsheet #8 Beaver Dam Management***
- ***BMP Factsheet #9 Watercourse Vegetation Management***
- ***BMP Factsheet #10 Aquatic Herbicides and Watercourse Maintenance***
- ***BMP Factsheet #11 Culvert Maintenance and Replacement***
- ***BMP Factsheet #12 Bridge Maintenance and Replacement***
- ***BMP Factsheet #13 Sediment Traps***
- ***BMP Factsheet #14 Constructed Watercourse Maintenance***
- ***BMP Factsheet #15 Fish Protection***
- ***BMP Factsheet #16 Water Quality Protection Measures***
- ***BMP Factsheet #17 Hand Maintenance***
- ***Informational Factsheet #18 Watercourse Classifications***
- ***Informational Factsheet #19 Drainage Water Quality***
- ***Informational Factsheet #20 Watercourse Re-vegetation***
- ***Informational Factsheet #22 Farm Practices***



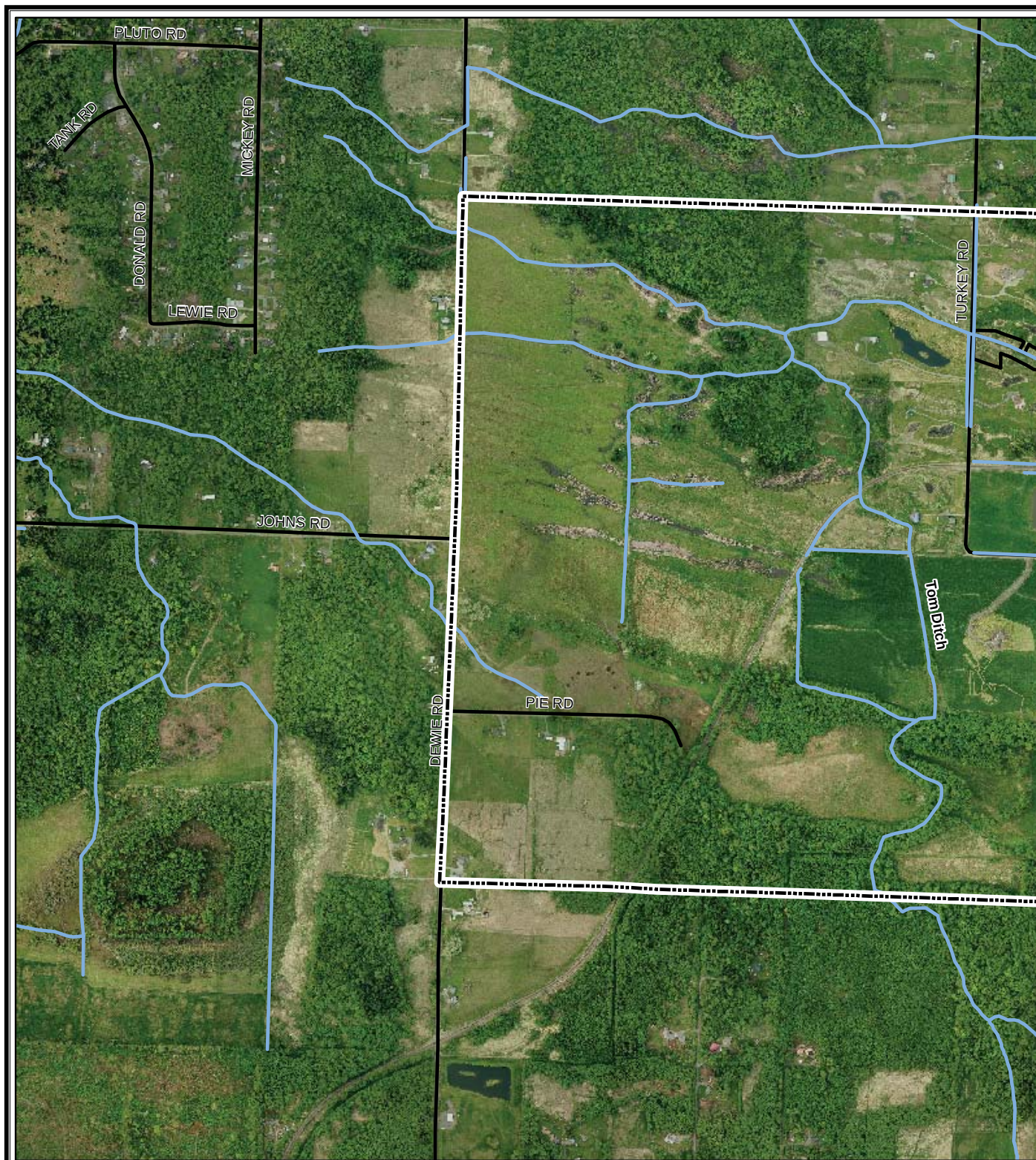


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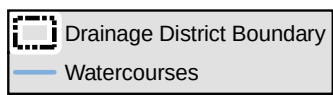
Figure 2

Whatcom County Drainage Improvement District #00 Map



1:12,000

Figure 2 continued



April 2009
Cartographer: Andrew Phay

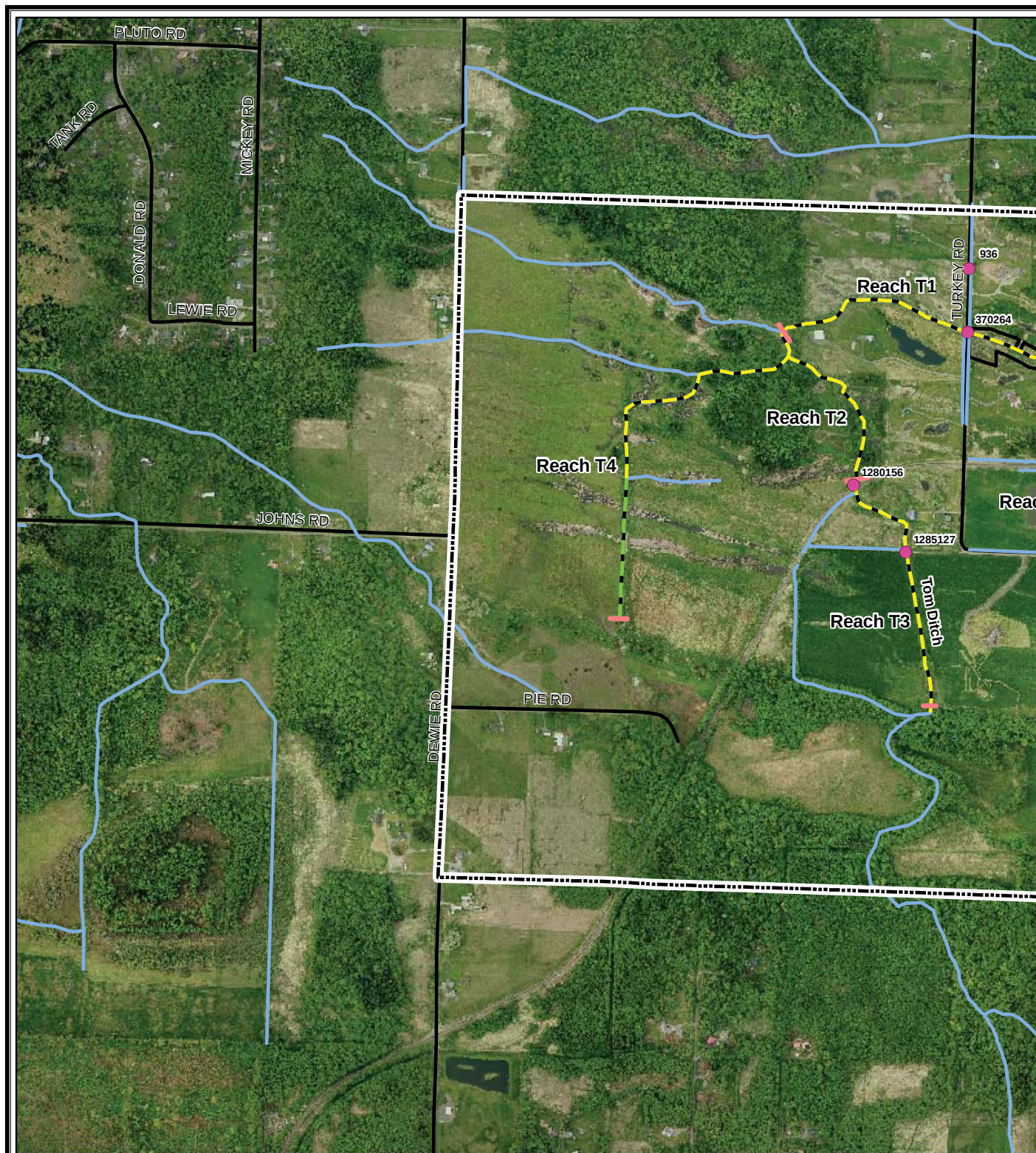


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Figure 3

Whatcom County Drainage Improvement District #00 Watercourse Classifications

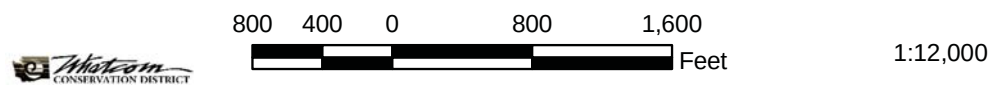
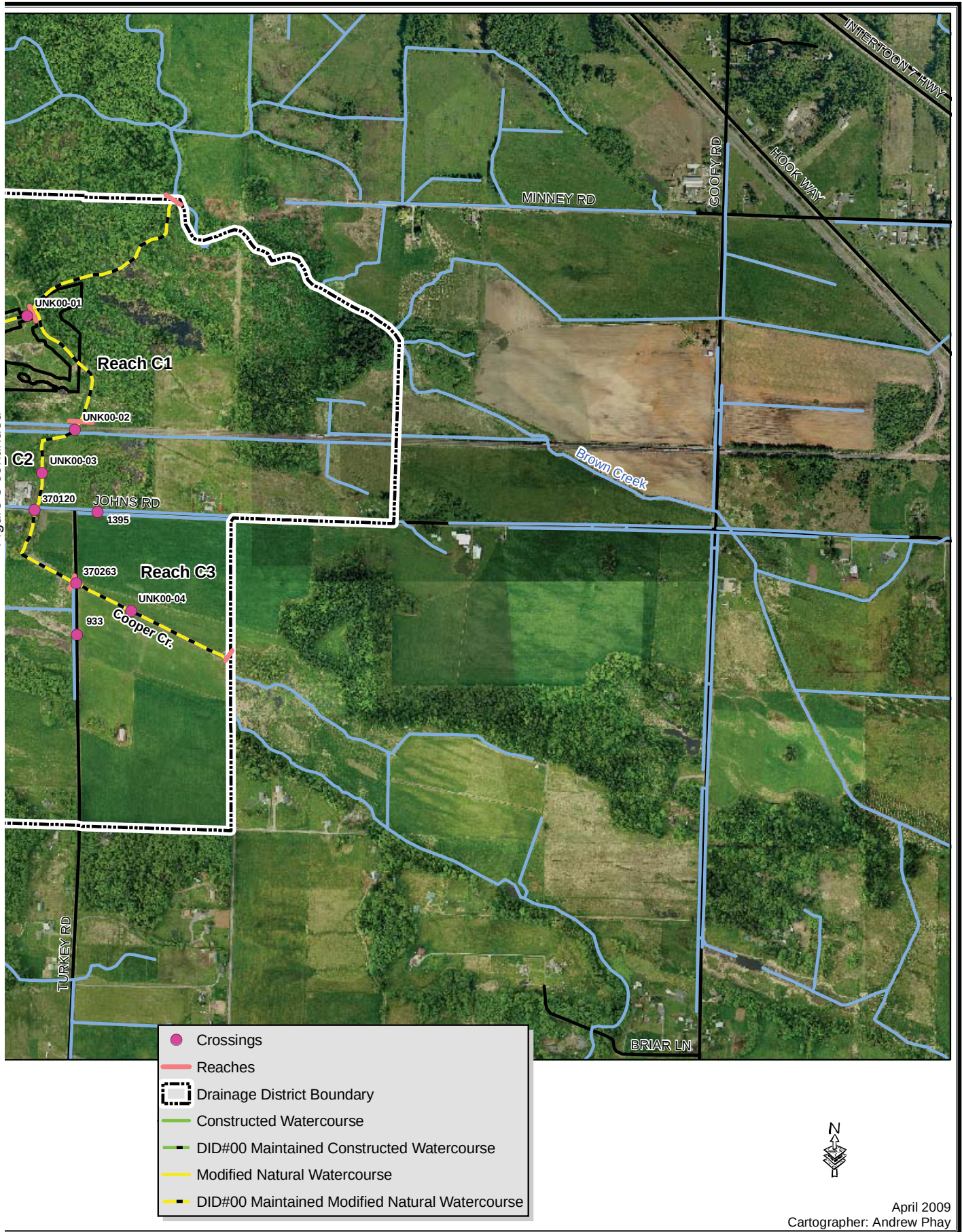


Figure 3 continued



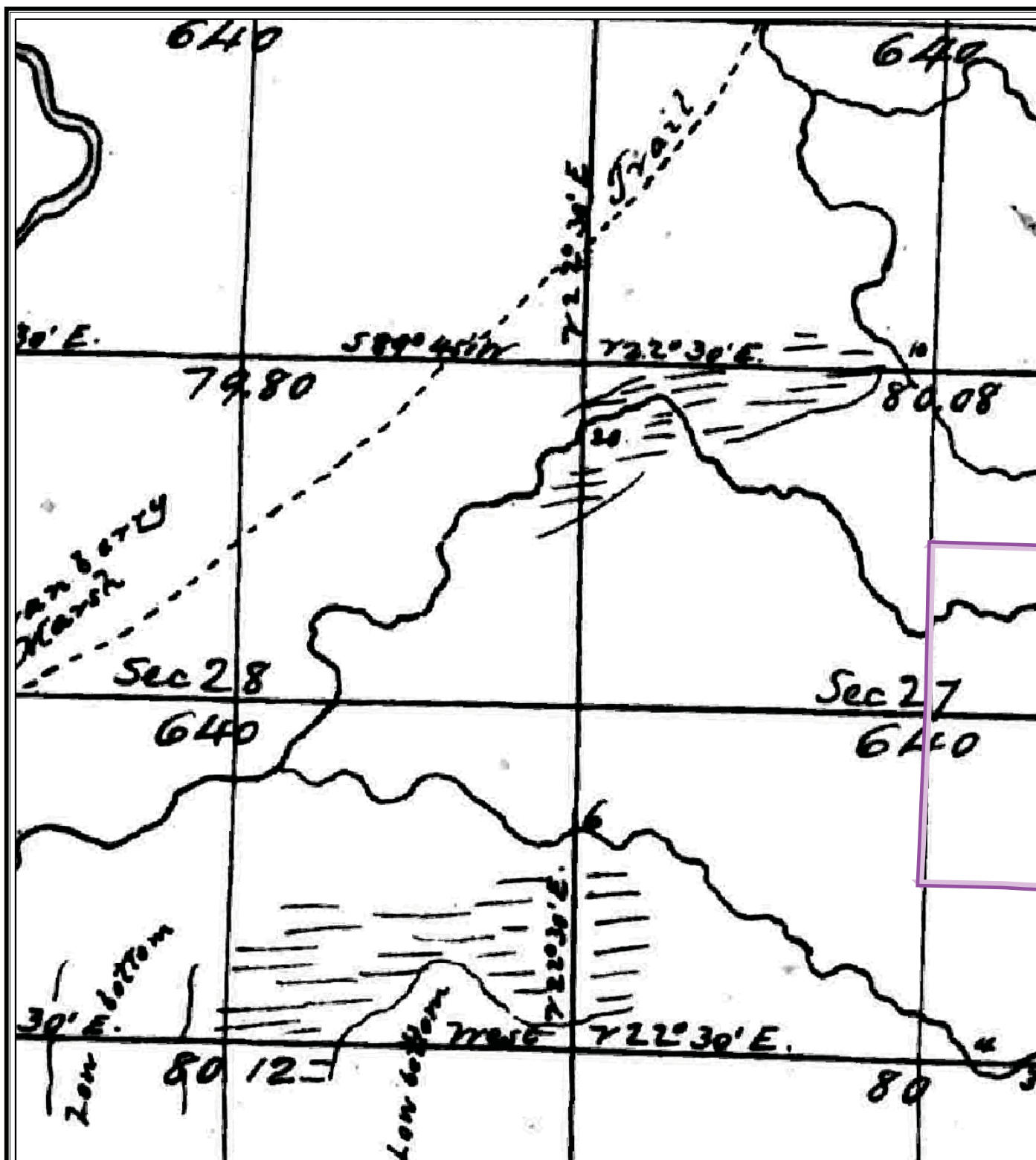


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Figure 4

Source: The General Land Office (GLO) of the United States, as part of their cadastral survey of the United States and its territories between about 1850 and 1890. The information was obtained from the Puget Sound River History Project of the University of Washington.

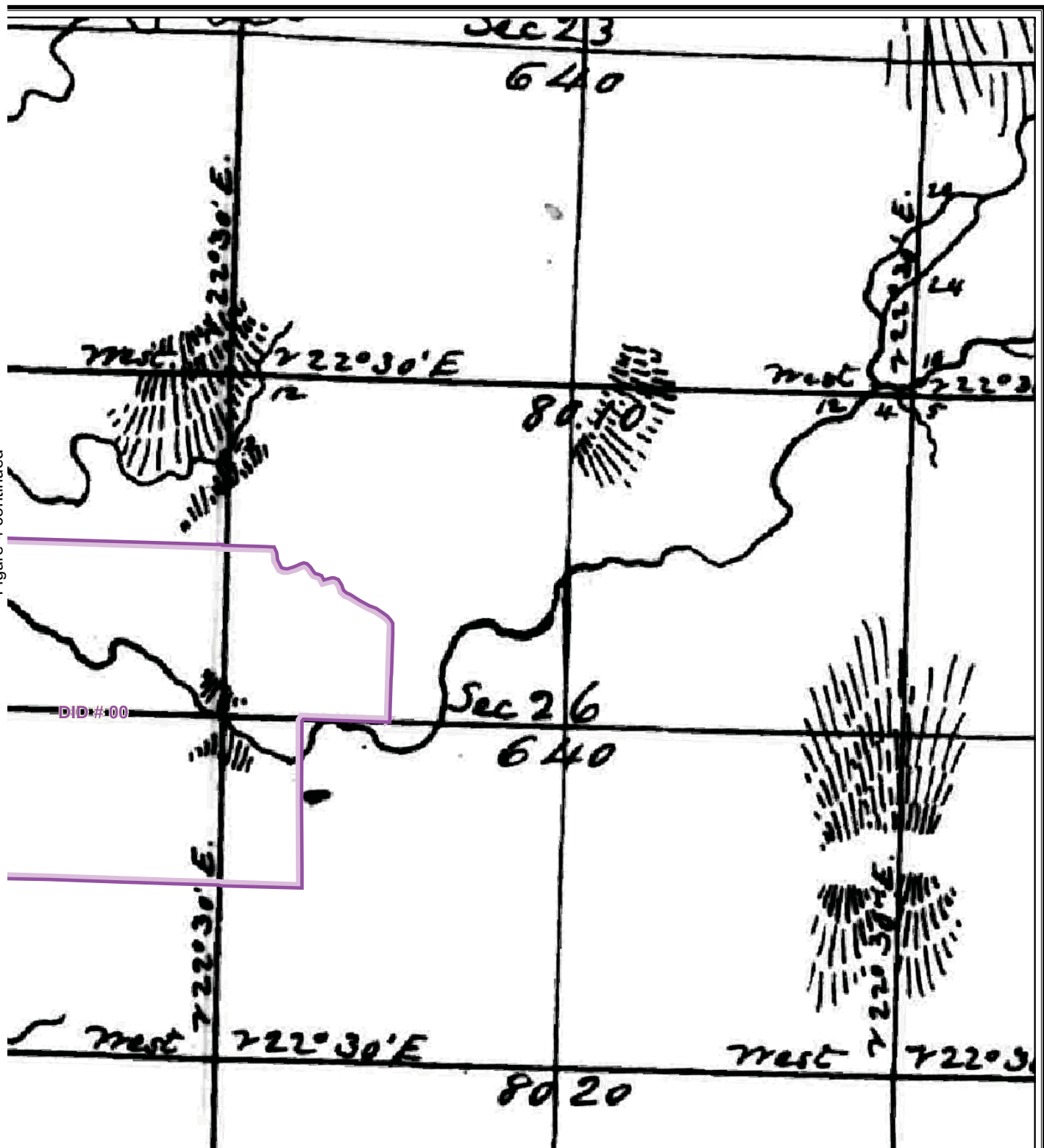
Whatcom County Drainage Improvement Dist Historic Conditions

1,000 500 0 1,000 2,000
Feet

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Figure 4 continued



ict #00



Wetland



Drainage District Boundary

Mar, 2009
Cartographer: Andrew Phay

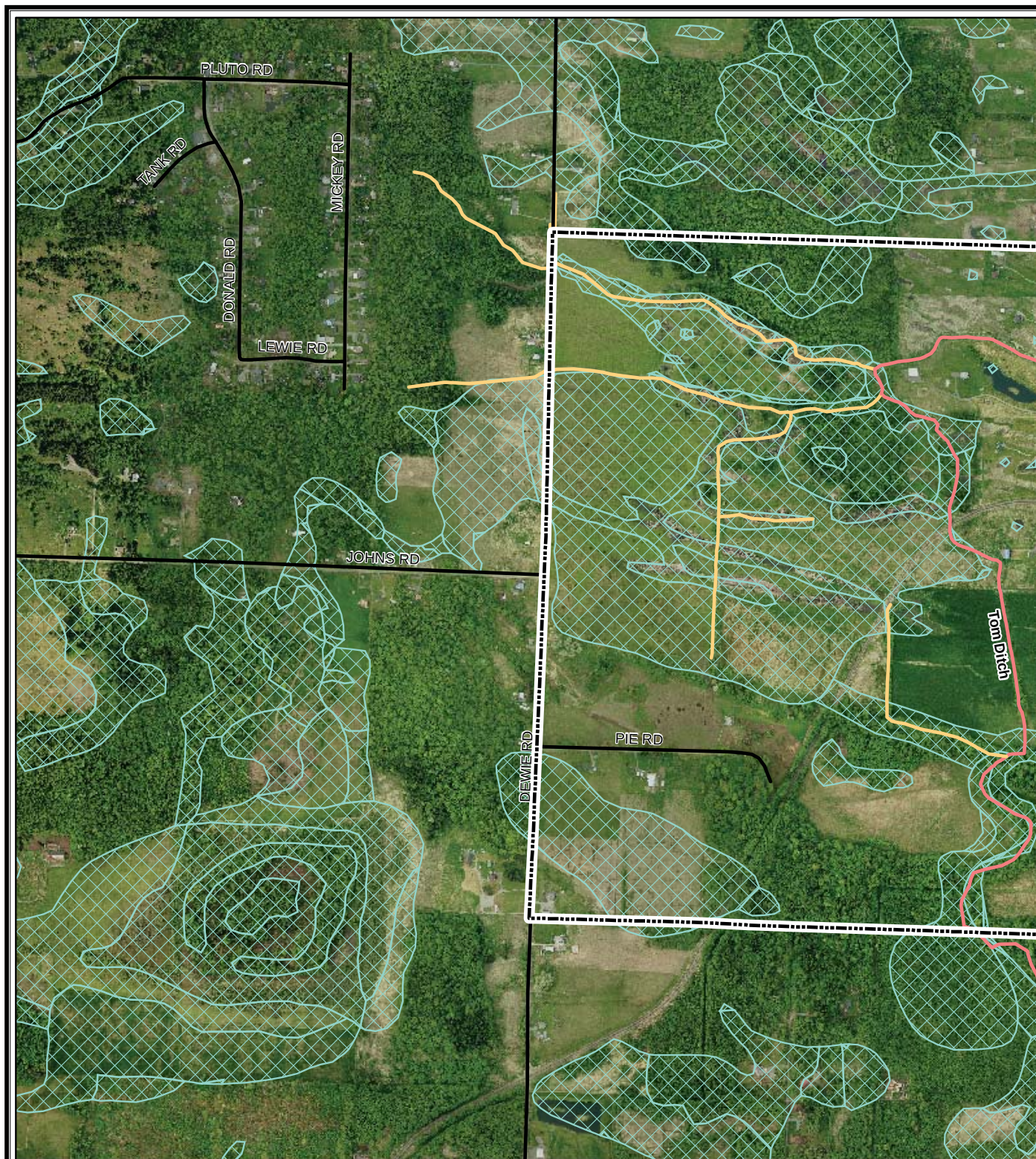


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Figure 5

Whatcom County Drainage Improvement District #00 Natural Features

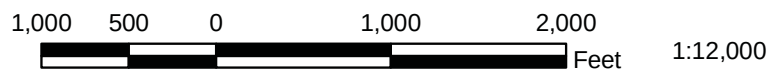
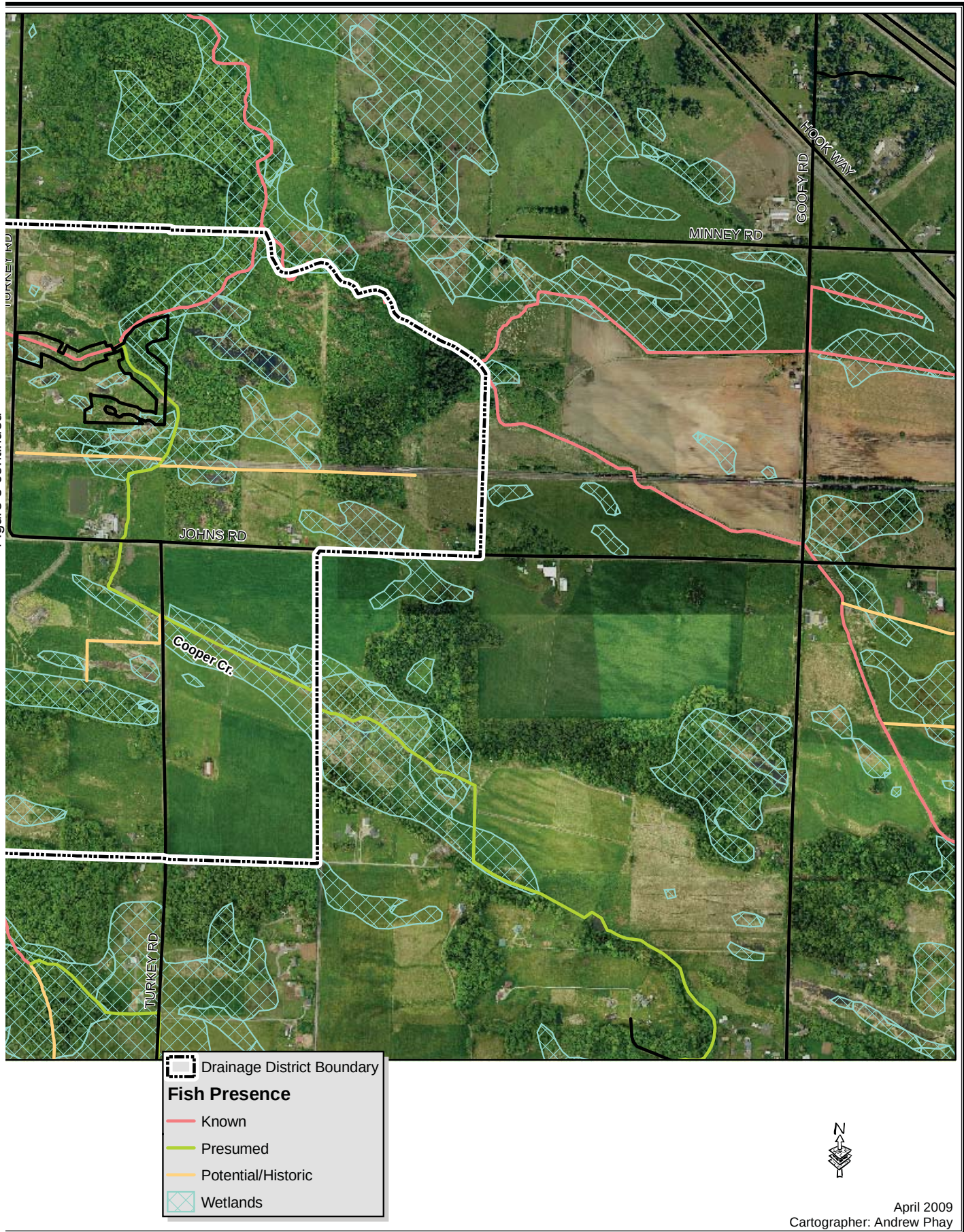


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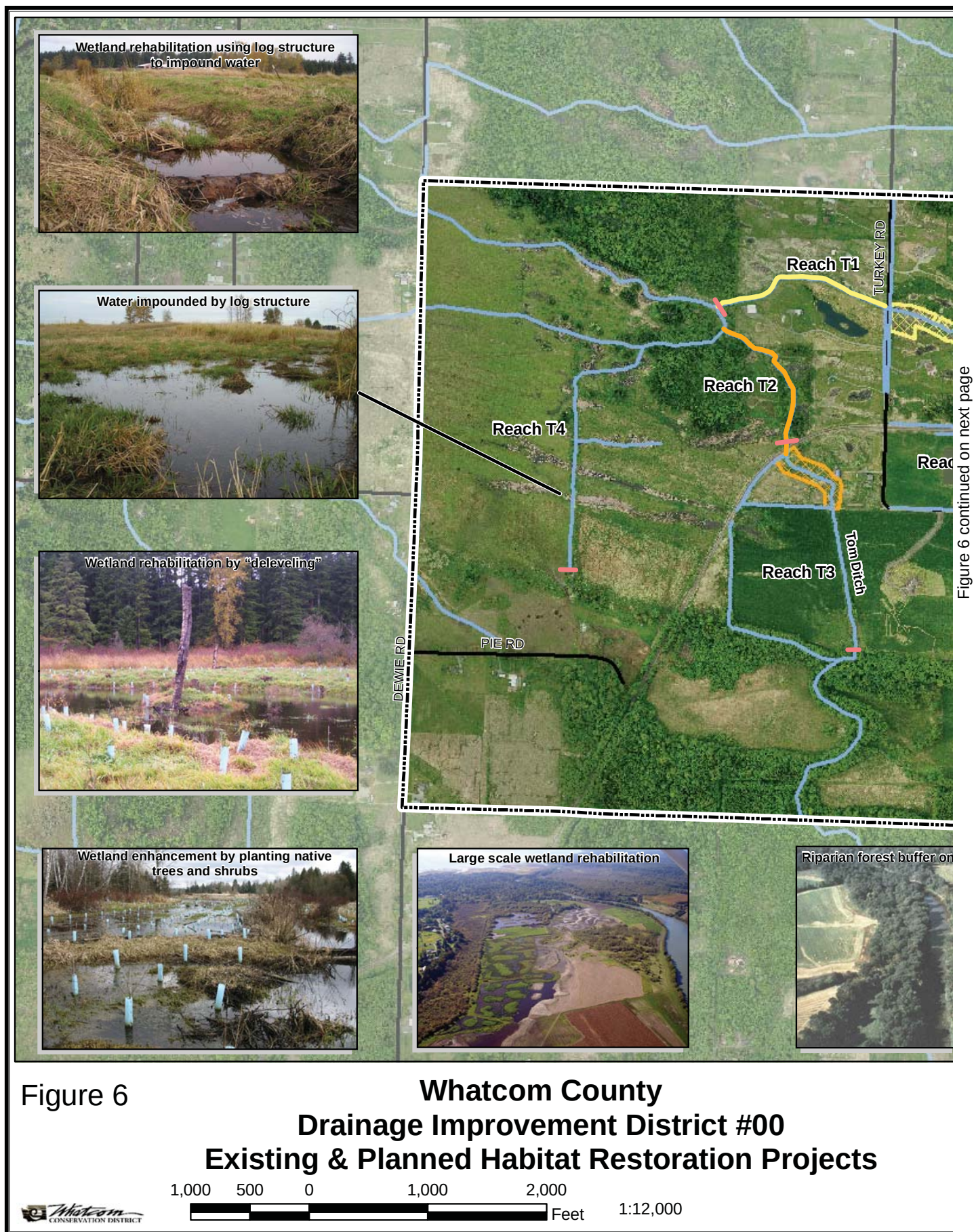


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Figure 6 continued

