Manual of Best Management Practices for Maintenance of Agricultural Waterways in King County

April 2012

King County
Department of
Natural Resources and Parks
Water and Land Resources Division

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Introduction and Background

This manual was written by the King County Agricultural Drainage Assistance Program (ADAP) and the Washington State University Extension. It covers the requirements and best management practices (BMPs) for ADAP projects that were developed in consultation with regulatory agencies, using input from an advisory committee.The consulting agencies were the Washington Department of Fish and Wildlife (WDFW), the Washington Department of Ecology, and the King County Department of Development and Environmental Services. The Advisory Committee was made up of local farmers, the King Conservation District, tribes, state agencies, and resource protection groups. The manual consists of two main sections (the Field Guide and the appendices) and is meant to be a tool to help owners of agricultural land improve the drainage on their property. The Field Guide is intended to provide detailed, step-by-step instructions for performing maintenance work on their drainage system. The appendices are intended to provide background information and explanations related to the steps detailed in the Field Guide.

The permitting required from federal, state, and local agencies can be very complex when working in waterways. The BMPs contained in this manual have been reviewed and deemed appropriate by the involved permit agencies. On properties inside the Agricultural Production Districts (APDs) and on most properties outside the APDs where agricultural activities (such as raising crops and livestock) occur, a property owner who develops a farm plan with the King Conservation District will need only one permit, a Hydraulic Project Approval from WDFW, to complete their project. Every completed project will provide additional information on how to improve drainage more effectively and efficiently, King County expects to continue working with regulatory agencies and farmers to update this manual as needed to incorporate what is learned from successful projects.

Reed canary grass choked waterway prior to ADAP project.

Reed canary grass choked channel after shading for several years.

PROPOSED ADAP PROJECT MANAGEMENT

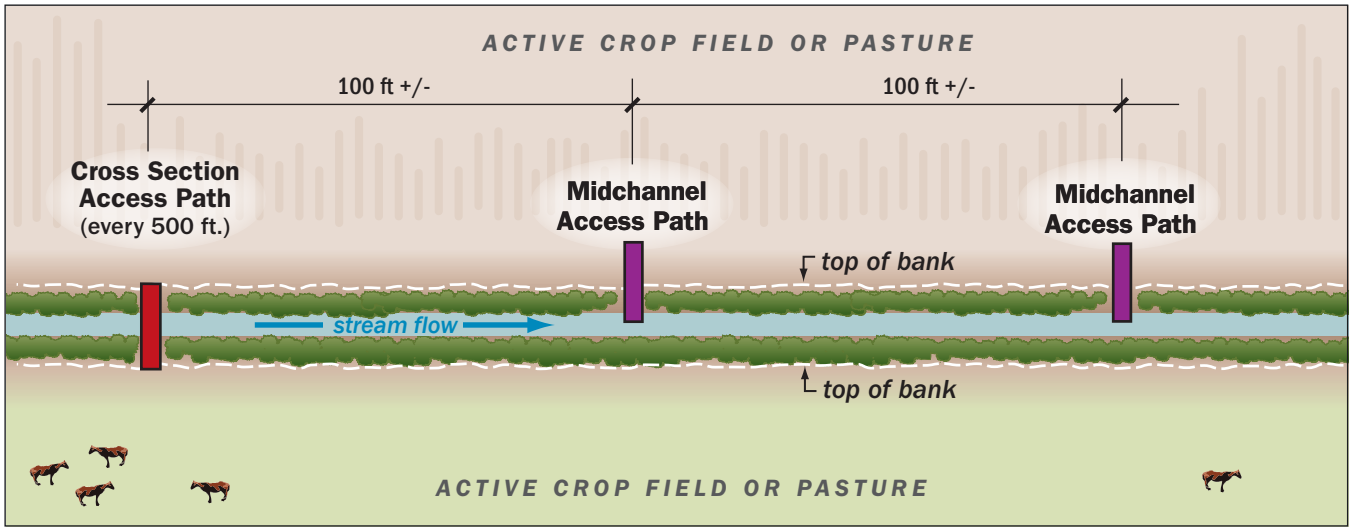
Task	Participants	Elements
INITIAL CONTACT	• Program Engineer • Owner	County staff and property owner will discuss the goals of a potential project. County staff will explain the assistance available through ADAP, explain the water course classification on the property and the implications, and discuss existing site conditions. If no farm plan exists, owner will be referred to KCD to start the process. Photos emailed to county staff of existing conditions can help determine if any vegetation removal is necessary to perform initial survey.
SURVEY	Program Engineer	County staff will perform a survey to help define the project and prepare a waterway profile with representative cross sections which are needed for the permit application.
WATERWAY CLASSIFICATION CONFIRMATION	Program Ecologist	If the property owner thinks the waterway on their property is incorrectly classified, an ecologist will re-evaluate the watercourse taking into account any properly collected information the property owner or others can provide.
CONSULTATION	• Program Manager and/or Program Engineer • Owner	County staff will deliver and explain the survey results. Project scope (e.g. vegetation removal, sediment removal, culvert replacement, length of project) will be agreed upon based on the survey results. If elements outside the ADAP are desired, the permit implications will be explained. County staff will "walk" through a project, and provide handouts, explaining the fish relocation, construction, erosion control, and planting requirements. County staff will provide a sample Hydraulic Project Approval (HPA) application and a template showing where to find required information.
PERMITTING BY OWNER	• Owner • Program Engineer	The property owner will fill out and submit the HPA application. County staff will be available for limited technical assistance such as explaining what is being asked for or explaining where to find information.
PRE-CONSTRUCTION MEETING (AFTER HPA ISSUED)	• Program Engineer • Contractor • Fish Salvage Crew • Owner (optional)	County staff and the contractor (owner if they desire) will meet approximately one week before the anticipated start of the project. Fish salvage staff will explain their role and the lead time they need to prepare the first construction segment. County staff will "walk" through the project with the contractor to make sure they understand the permit requirements and have the appropriate equipment needed for site conditions.
CONSTRUCTION	• Program Engineer • Fish Salvage Crew • Contractor	County staff will be have limited time to visit the site during construction. Staff will be available by phone to answer questions. Fish salvage staff will be on site every day to salvage fish during dewatering of the day's construction area and to prepare the following day's construction area.
INSPECTION	Program Engineer or others	King County Code requires inspection by one of four agencies (WLRD, DDES, KCD, or WDFW) in lieu of obtaining a grading permit. ADAP staff will visit the site at the end of the construction phase to verify that all BMPs have been implemented properly. The owner should notify the ADAP engineer of the expected work completion date as soon as it can be estimated so the engineer can schedule time to inspect the work before equipment is removed from the site.
PLANTING	Contractor	The property owner is responsible for installing the required number and types of plants in order to receive the planting cost share. County staff are available for technical assistance during planting. After planting is complete, county staff will inspect planting and approve 75% of the cost share total if the plants have been properly planted.
PLANT MAINTENANCE AND WATERING	Owner	The property owner is responsible for maintaining and watering plants until they are established. Maintenance includes mowing around the plants if weed fabric is not used and removing the weed fabric after the plants are established if it was used. If no weed fabric is used, a property owner can expect to mow reed canary grass 2-3 times a year for 2-3 years. County staff will inspect the plants after one year and approve the final 25% of the cost share if 80% of the required plants are surviving.

Phase 1.
Pre-construction: Vegetation Management

This chapter focuses on the vegetation management Best Management Practices (BMPs) needed for the initial survey and fish relocation. These activities usually occur many weeks apart but, if it can be shown that it is more efficient and cost-effective to perform all vegetation management at one time, that is allowed. See Appendix C for more information.

Vegetation Removal for Survey Access

A survey is required for each project to help define the scope of the project and to create a profile of the waterway for permitting. When vegetation needs to be removed to perform the survey, it is limited to cross section and mid-waterway access paths and should be performed with hand tools (machete, rake, weed whacker) to minimize impact to the waterway. If a property owner wants to perform all vegetation management required for the project at one time, additional BMPs are required. Consult with the ADAP engineer for details.

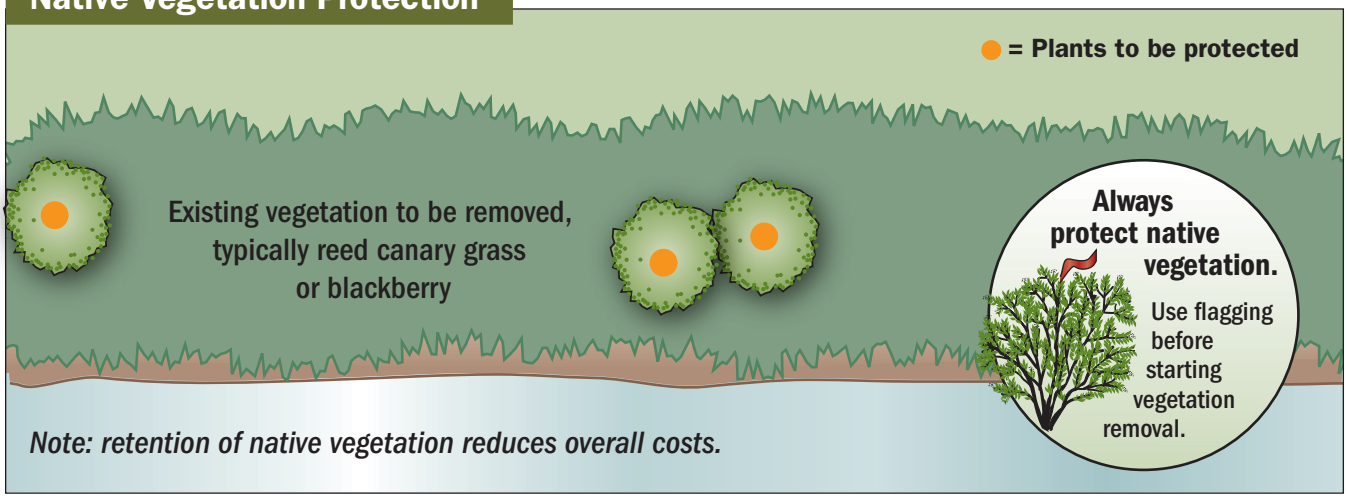


- **Cut midchannel access paths** (between 2.5–5 feet wide) every 100 feet along drainage channel and also at points of interest like culverts, known high points and obstructions. Cut vegetation from top of bank to midpoint of channel.
- **Cut cross section access paths** (between 2.5–5 feet wide) every 500 feet. Cut from top of bank to top of bank.

Three native plants protected during initial clearing and construction.

Native vegetation protected during construction and incorporated into planting plan.

Native Vegetation Protection



Protection of native vegetation is critical during vegetation removal; this should be done by flagging or otherwise marking native plants. Native vegetation larger than 3" in diameter should not be removed to the extent possible. Native plant retention reduces the overall cost of a project and all reasonable measures to reduce damage to native plants should be used.

Non-native Vegetation Removal Techniques:

- **Hand removal (machete, rake, scythe):** No additional restrictions
- **Hand-held mechanical (e.g. weedeater):** Do not operate below the water surface
- **Mechanical removal (e.g. mower, backhoe):** Do not disturb soil on the bank/slope or in the water

Vegetation Removal for Fish Relocation

In order to properly remove fish from a construction area, the fish salvage crew must have access to the water column. Different types of fish salvage techniques require different types of vegetation removal. Vegetation has to be removed to allow access into the waterway for the fish salvage crew but also must allow movement of the electrofishing unit throughout the waterway.

Vegetation removed for fish relocation.

Fish relocation/salvage with electroshock unit.

If Reed Canary Grass Has Not Filled The Entire Channel:

The fish salvage crew needs room to work in the channel. The crew requires about 2.5 feet of clear water to work in. If the waterway already provides adequate room, no vegetation removal is needed.

A hand-held weed whacker can easily cut an access point for fish relocation and construction, but care is needed to prevent vegetation from entering the waterway. A silt fence or block net should be installed to catch material that does enter the waterway.

If Reed Canary Grass Has Filled the Entire Channel:

- Create 2.5 foot wide work area in channel similar to photo above.
- All vegetation that must be removed from the channel should be placed above the high water mark for later removal.
- Mowing equipment may not be operated below the water surface (if present), nor disturb soil.
- For vegetation removal below the water surface, heavy machinery is limited to a thumbed bucket or rock picker.

Blackberry and Other Mixed Vegetation Removal

- Blackberry vines/bushes and other non-native plants shall be removed from one side of the channel and cleared from the other side of the channel to the point that they will not hang into or over the water.
- All vegetation removed should be kept out of the water. Alternatively, a block net or silt fence can be placed at the downstream end of the project to catch material that then must be removed from the waterway.
- All vegetation removed should be placed above ordinary high water mark for later removal.
- No machinery should operate below water surface.
- No machinery should disturb the banks of the waterway. Long term blackberry vine/bush control, such as removing the root balls, can be performed during construction. Discuss with ADAP Engineer.

Knotweed Removal

Note:
Do not mow knotweed, or other noxious weeds. Knotweed can easily spread from even very small pieces.

If knotweed or other noxious weeds are present, contact the King County Noxious Weeds Program at 206-296-6519 for specific removal BMPs.

Herbicides

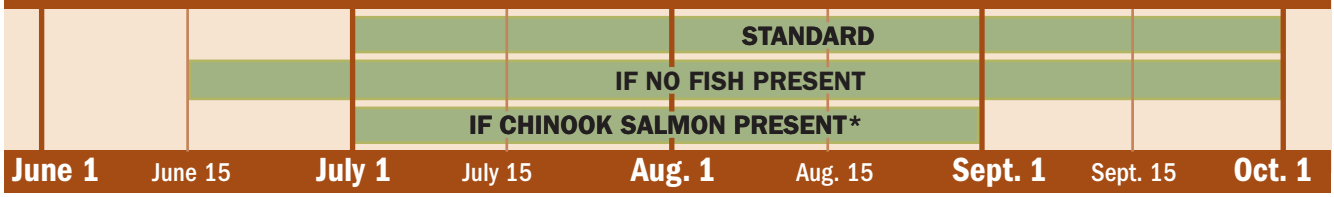
Vegetation control via herbicides must be performed by a licensed pesticide applicator holding an Aquatic Pest Control category (***http://agr.wa.gov/PestFert/docs/Form4375.pdf***). Dead vegetation must be removed from waterway.

Note:
The Aquatic Plant and Algae General Permit must be applied for at least 60 days in advance of intended application. If you intend to use herbicides, please discuss this with the King County Project Engineer or Manager.

Phase 2.
Construction

This chapter focuses on the activities that will occur during the construction phase of the project. The practices outlined here will be discussed with the King County Program Engineer or Manager during the pre-construction meeting. More detail outlining the rationale behind the BMPs and the pros and cons of each practice can be found in Appendices D, E, F, G and/or H.

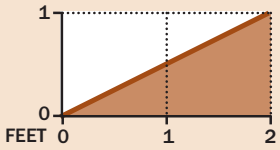
Timeframe for Construction Activities



*Determined by WDFW staff.

General BMPs

- Projects must be completed in the appropriate timeframe shown above.
- Sediment removal must not occur lower than the historic bottom of the channel.
- Approved sediment control measures include silt fences, coir logs, culvert obstruction, or silt dam. Turbidity measurements (see page 12) will determine if sediment control measures are adequate.
- Projects can proceed either upstream or downstream. See page 13. Discuss direction of construction with ADAP Engineer.
- Side slopes of the channel must not be changed, except to reduce future instability of the waterway. Discuss with ADAP Engineer if you think your channel is unstable.
- Side slopes, when altered, must not be flatter than 2H:1V.
- If a bypass is required, energy dissipation measures such as a blue tarp, plastic, or large bucket are required at the discharge point of the bypass pump.
- Spoils can be spread in active crop fields or pastures. The depth of the spread spoils must be less than 6 inches.
- Work will take place from the **north** or **east banks** whenever possible because disturbance of these banks will have less impact on riparian shading of the waterway.

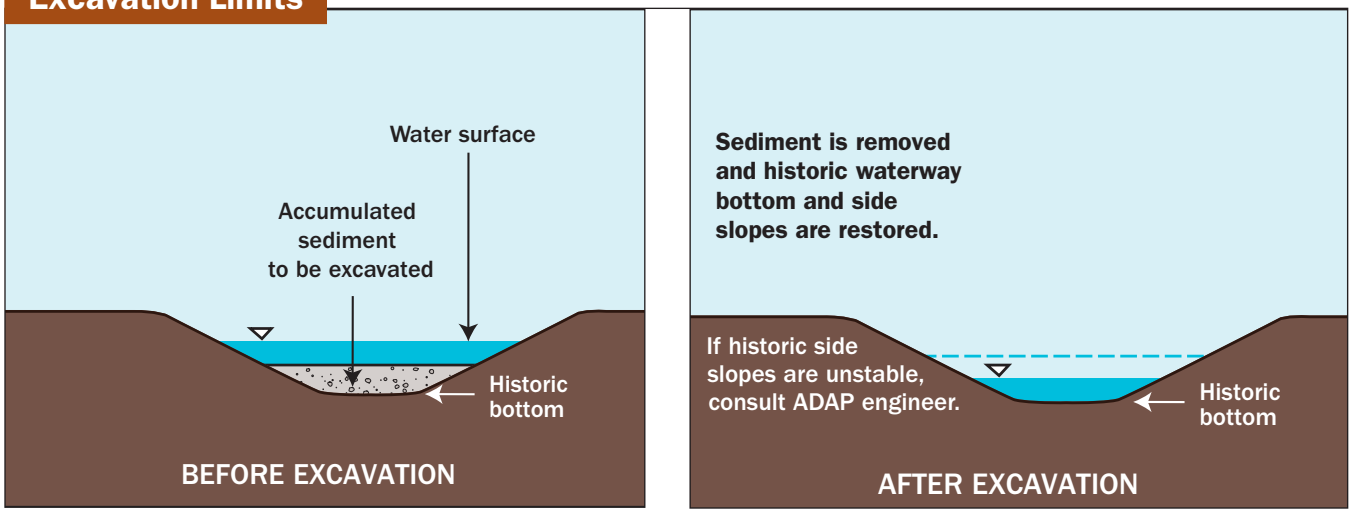


2H:1V means the slope rises 1 foot for every 2 feet travelled horizontally.

- Leave sediment barriers in place for 24 hours after re-introducing water into the waterway or until after erosion control BMPs are in place, whichever is longer.

One reason the permitting is easier in the streamlined ADAP is that work is limited to maintenance of the existing waterway as opposed to creating a new waterway or expansion of an existing waterway. Maintenance means removing accumulated sediments to re-establish the historic dimensions of the waterway. The historic waterway bottom is determined during the initial survey by probing the bottom of the waterway with the survey rod for a change in material. The bottom of existing culverts can also indicate the historic waterway bottom. If the banks of the existing channel are too steep and will slough into the maintained channel, consult with the ADAP engineer for options.

Excavation Limits



Construction equipment

The type of equipment used can greatly influence how successful an ADAP project is. The equipment boom must be long enough to reach the bottom of the waterway while staying off the waterway side slopes. The bucket used must be toothless to minimize disturbance of material below the historic waterway bottom.

If a toothless bucket is not available, weld a steel plate to the teeth.

Operate equipment only from the top of the channel bank. Equipment crossings in the waterway are not allowed. If you need to cross the channel, use an existing culvert or bridge.

Spread spoils in active crop fields or pastures in a layer no deeper than 6 inches. If no acceptable location exists on site to spread the spoils, they must be hauled off site to a proper disposal site.

Sediment Control

When water and soil mix the result is muddy water, also called turbid water. Turbidity is a measurement that corresponds to the amount of sediment in the water. Sediment control best management practices (BMPs) reduce the amount of sediment in the water.

Common sediment control BMPs include silt fences, coir logs, culvert obstruction, silt dams and rock check dams. If the common BMPs do not adequately control sediment leaving the site, additional BMPs such as covering exposed areas, modifying the construction techniques, or postponing the project until dryer weather are required.

Sediment control BMPs must be installed first in the construction sequence. Depending on the direction of work (downstream to upstream or upstream to downstream) sediment control BMPs may remain in the same place for the duration of the project or may move in conjunction with the work area. After the required sediment control BMPs are installed, work can proceed. Additional sediment control BMPs need to be readily available in case state water quality standards are not met (See page 10).

A silt fence (below) is a geotextile that is installed perpendicular to the water flow. Silt fences either slow water down similar to a coir log), filter water, or both depending on the type of geotextile used. The proper choice of geotextile depends on the amount of water of water flowing in the channel and the amount of turbidity created by the construction techniques involved. Consult with the ADAP engineer to determine what is best for your site.

Silt fences must fit snugly to the bottom of the waterway and need to have adequate support. Wooden stakes are commonly used to support a silt fence in low flow waterways. When there is more water flowing, additional support is needed such as metal post with wire fencing reinforcement or placing washed rock in front of and behind the silt fence.

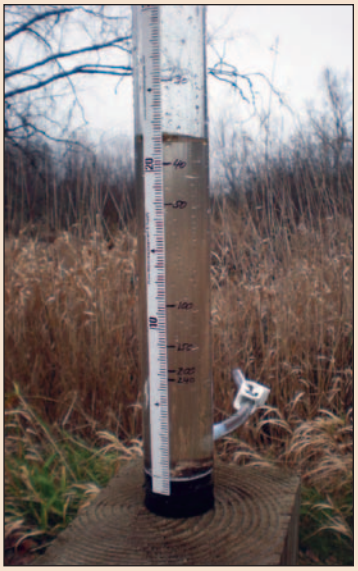
Coir logs are staked in place to fit snugly to the bottom of the waterway and to create a dam. Water behind the dam slows down which allows sediment to settle to the bottom of the waterway.

Properly installed coir logs will allow water to spill over the low point in the middle of the waterway before it gets deep enough to flow around the ends on the bank.

Turbidity Measurement

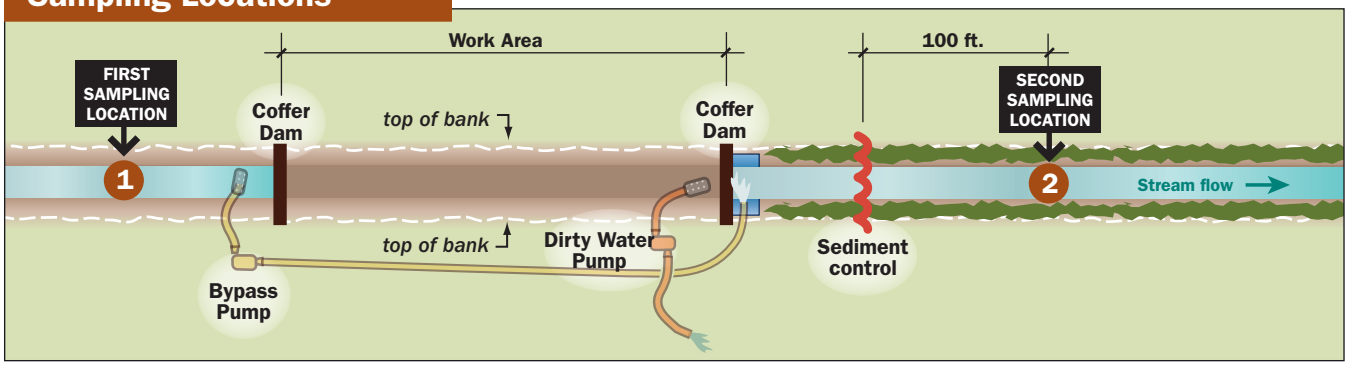
Washington State Water Quality Standards require that the turbidity (cloudiness) of water leaving the work area be measured by the contractor. Turbid water can adversely impact downstream properties by depositing sediment. The sediment can also suffocate fish and their egg nests (redds). Turbidity is measured in Nephelometric Transparency Units (NTU) using either a turbidimeter or a transparency tube. State water quality standards apply to all construction projects, not just ADAP projects, so most contractors have the proper equipment need to measure turbidity. If a contractor does not have the proper equipment, they can contact the ADAP engineer to learn about options for purchasing or borrowing what is needed.

1. Turbidity measurements must be made upstream of the project before the start of construction each day to provide a baseline measurement.
2. After the baseline turbidity is measured and documented, measure the turbidity at least 15 minutes after the start of construction at a point 100 feet downstream of the most downstream sediment control device.
3. Water quality standards require that the turbidity of the water leaving the project (discharge turbidity) not exceed baseline turbidity by more than 5 NTU for baseline turbidity less than 50 NTU. For baseline turbidity over 50 NTU, the discharge turbidity must be less than 10% above baseline turbidity.
4. Discharge turbidity must be measured every hour for the first day of construction.
5. If water quality standards are exceeded, construction must stop and modification to sediment control measure must occur or additional sediment control measures installed. Once modification/additions are made, discharge turbidity must be measured 15 minutes after construction resumes.
6. All turbidity measurements should be recorded on the Water Quality Monitoring Data Sheet. (See Appendix K).
7. After the initial construction day, if there has been no exceedence of water quality standards, turbidity measurements shall be taken three times during the day -- at least 15 minutes after the start of construction, midway through the day, and within an hour of the end of the day. If water quality standards are exceeded, repeat step 5 and measure discharge turbidity every hour for the rest of that day.



Transparency tube is used to measure turbidity.

Sampling Locations



ADAP Turbidity/Transparency Sampling Log

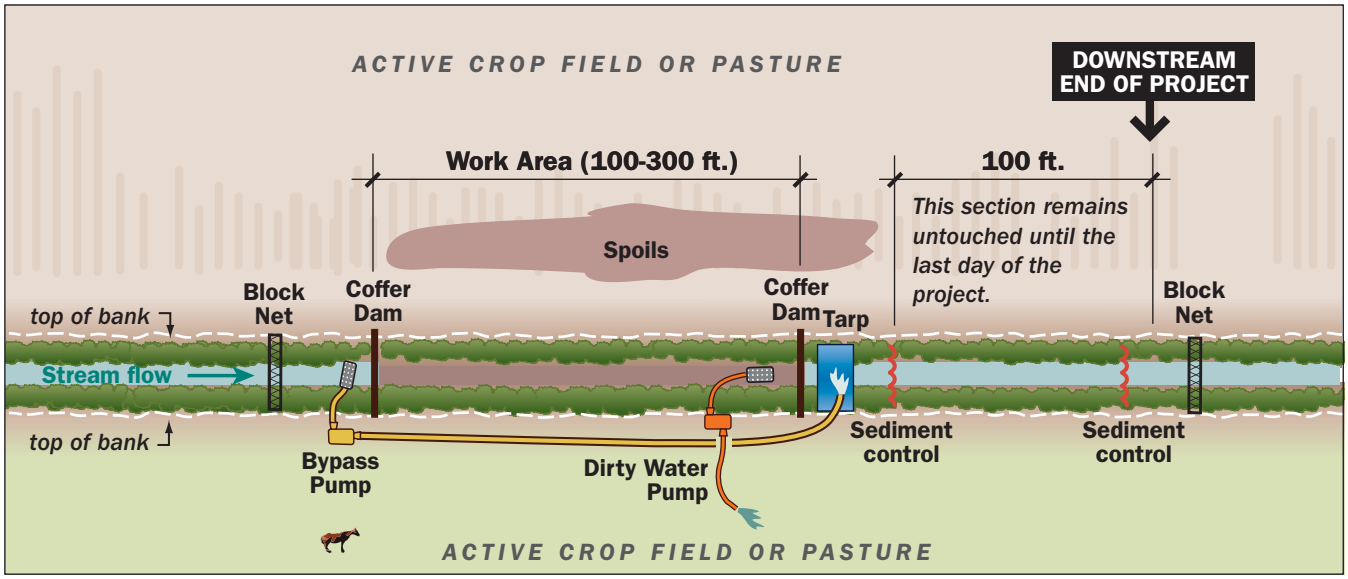
Site: SWAMP FIELD FARM

Sampler: Johnny Field **Method Used:** Transparency tube or Turbidimeter
Circle one

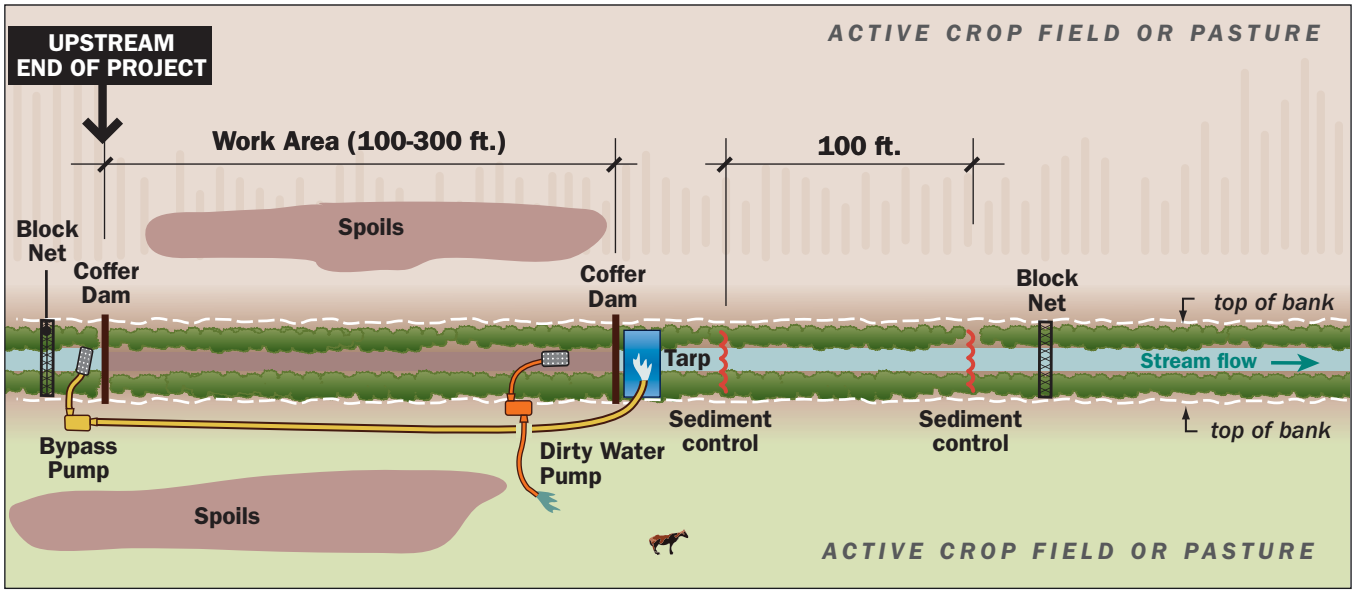
	Date	Time	Place	Baseline Turbidity	Discharge Turbidity	Comments
			Unique descriptor of sampling site	cm or NTU	cm or NTU	
Example	7/25/2011	9:15 AM	Outlet of 12" pipe by barn	32 NTU		
1						
2	4/16/2012	8:05 AM	OUTLET of 30" pipe	41 NTU	4	
3	4/16/12	8:15 AM	" "		43 NTU	
4	↓	9:15	" "		40 NTU	
5		10:18	" "		44 ↓	
6		11:15	" "		41	
7		12:05 PM	" "		39	
8		1:15	" "		40	
9	↓	2:10	" "		42	
10	4/16/12	3:15	" "		44 NTU	
11						
12	4/17/12	9:10 AM	OUTLET of 30" PIPE	44 NTU		
13	4/17/12	9:21 AM	" "		42 NTU	
14	"	12:00	" "		46 NTU	
15	4/17/12	4:30 PM	" "		44 NTU	
16						
17	4/18/12	8:20 AM	OUTLET of 30" PIPE	39 NTU		
18	4/18/12	8:25 AM	" "		41 NTU	
19	4/18/12	12:15 PM	" "		48 NTU	MORE THAN 5 NTU OVER 5
20						BASELINE, ADDITIONAL
21						COIR LOGS ADDED.
22	4/18/12	1:00 PM	OUTLET of 30" PIPE		43 NTU	6
23	↓	2:00 PM	" "		43 NTU	
24		3:00 PM	" "		42 NTU	
25		4:00 PM	" "		43 NTU	
26						

Direction of Construction

ADAP projects can proceed from the downstream end of the project to the upstream end of the project (D to U) or from the upstream end of the project to the downstream end of the project (U to D). While the BMP concepts are the same regardless of the direction of the work, the logistics of implementing the BMPs are slightly different. In general, D to U projects are more efficient and cheaper but a property owner should discuss the direction of work with the ADAP engineer to determine what is best for their particular property.



For D to U projects, sediment control measures shall be installed at the downstream end of the project and 100 feet upstream from the end of the project. The channel between the sediment control measures shall remain untouched until the end of the project when it will be the last section to be cleaned. For long projects, install another sediment control device every 1,000 feet.



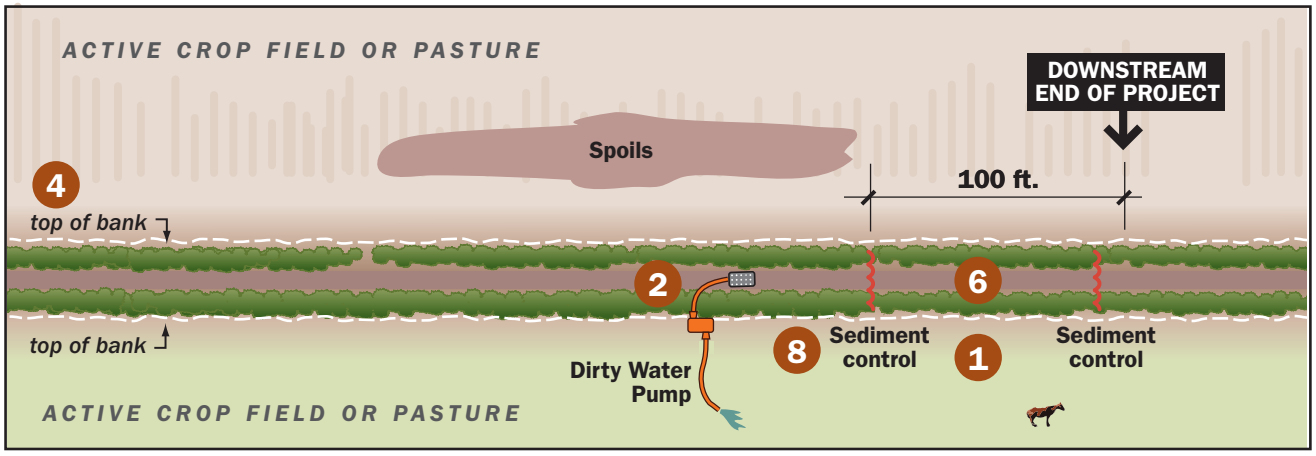
For U to D projects, a sediment control measure shall be installed at the downstream end of that day's work area and 100 feet further downstream, leaving the channel between sediment control measures untouched. The sediment control measures should be left in place overnight and moved to the end of the next day's work area before work starts the next day.

Insufficient Water Present To Support Fish

STEPS FOR NON-BYPASS BMPs:

If the county's fish salvage supervisor determines there is not enough water present, or the water present is of such poor quality that fish could not survive in it, the project can proceed without a bypass. Projects with insufficient water present to support fish should proceed from downstream to upstream (D to U; see page 12) because even though insufficient water may be present before the project starts, after sediment is removed from the waterway, it is very common for water to seep into the waterway. If a project is very long, the seepage can result in enough water flowing in the waterway to cause erosion. If field tiles are opened during the project, the amount of water flowing into the waterway can be significant. For multi-day projects, it could also rain before the end of the project resulting in flow in the waterway. If a project can proceed without a bypass, follow these steps:

1. Install approved sediment control measures according to the downstream to upstream (D to U) detail on page 12.
2. If groundwater enters the channel after sediment is removed, the turbidity of the water leaving the project must be measured (see page 10). If the water is coming from a field tile, measure the turbidity of the water coming out of the tile and use that as the baseline turbidity. If the water flowing in the waterway is seeping from the banks, use zero as the baseline turbidity. If state water quality standards are exceeded, install more erosion control measures or use a dirty water pump to pump water into the surrounding fields.
3. If water is entering the waterway from field tiles and it is causing erosion, plug or restrict the flow out of the tiles.
4. Continue sediment removal to the upstream end of the project.
5. For long projects where water seeps into the waterway or field tiles drain into the waterway, the flow of water can be significant over the length of the project. For long projects, install another erosion control measure every 1,000 feet.
6. Move to the downstream end of the project and clean the last 100 feet of the project starting at the downstream end and working upstream.
7. If any water is flowing in the channel after sediment removal, allow channel to flow for at least 24 hours with sediment control measures in place.
8. Remove accumulated sediment from in front of sediment control measures.
9. If sediment is still moving in the channel, repeat steps 7 and 8. Otherwise remove sediment control measures.

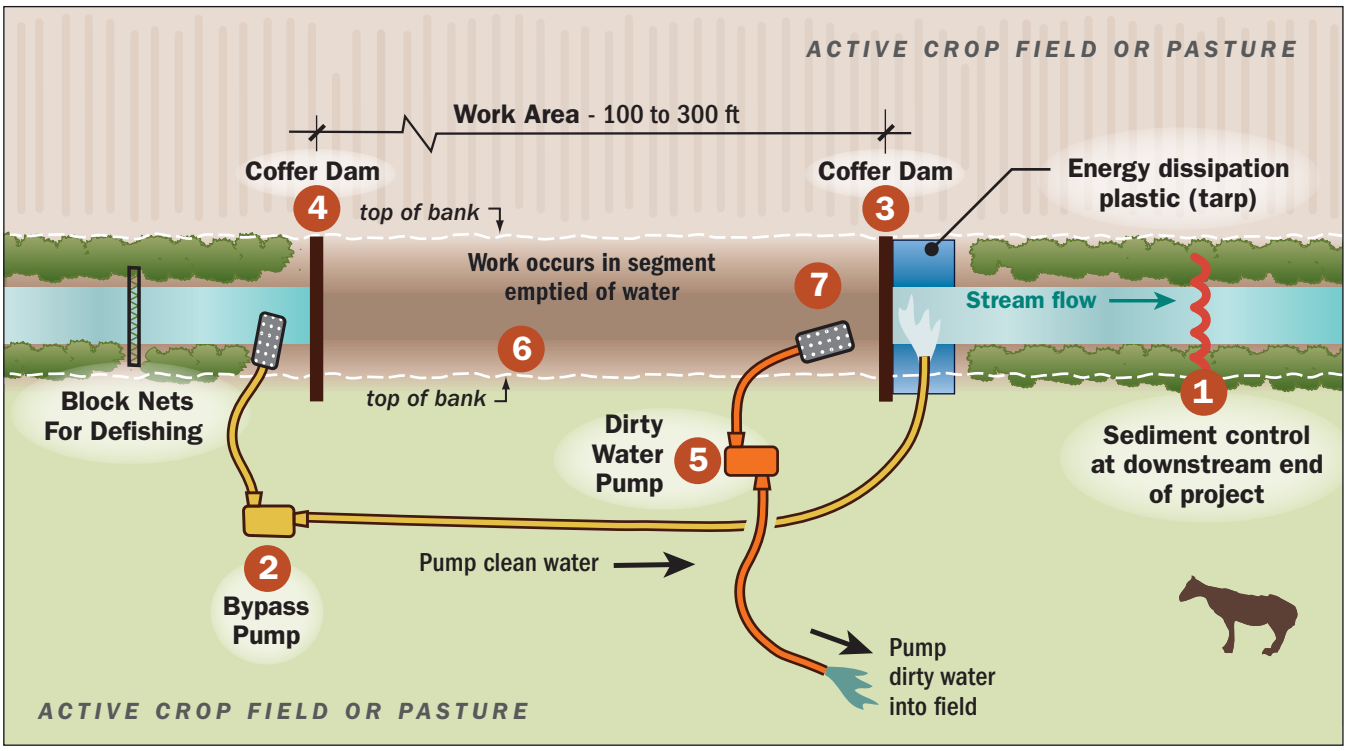


Wet Conditions (sufficient water present to support fish)

STEPS FOR BYPASS BMPs:

When the fish salvage supervisor determines there is sufficient water present or flowing in the waterway to support fish, a bypass is required. The bypass system generally consists of two coffer dams (steel plates are commonly used) and two pumps (the bypass pump and the dirty water pump). To install a bypass, follow these steps:

1. Install sediment control devices as required for the direction of construction (see page 12).
2. Set up the bypass pump and energy dissipation measures at the discharge point, then start pumping. The waterway downstream of the work area cannot be allowed to dry out. There must always be flowing water in the waterway. Use a perforated bucket or other measure to prevent scour at the pump intake.
3. Install the first coffer dam just upstream of the discharge point for the bypass pump.
4. Install the second coffer dam just downstream of the bypass pump intake.
5. Setup the dirty water pump and start pumping the water in the channel between the coffer dams into the adjoining fields at a location where it cannot flow back into the channel prior to having the suspended sediments removed.
6. The fish salvage crew will catch stranded fish as the water level drops and relocate them outside of the project.
7. Begin sediment removal at downstream end of construction area.



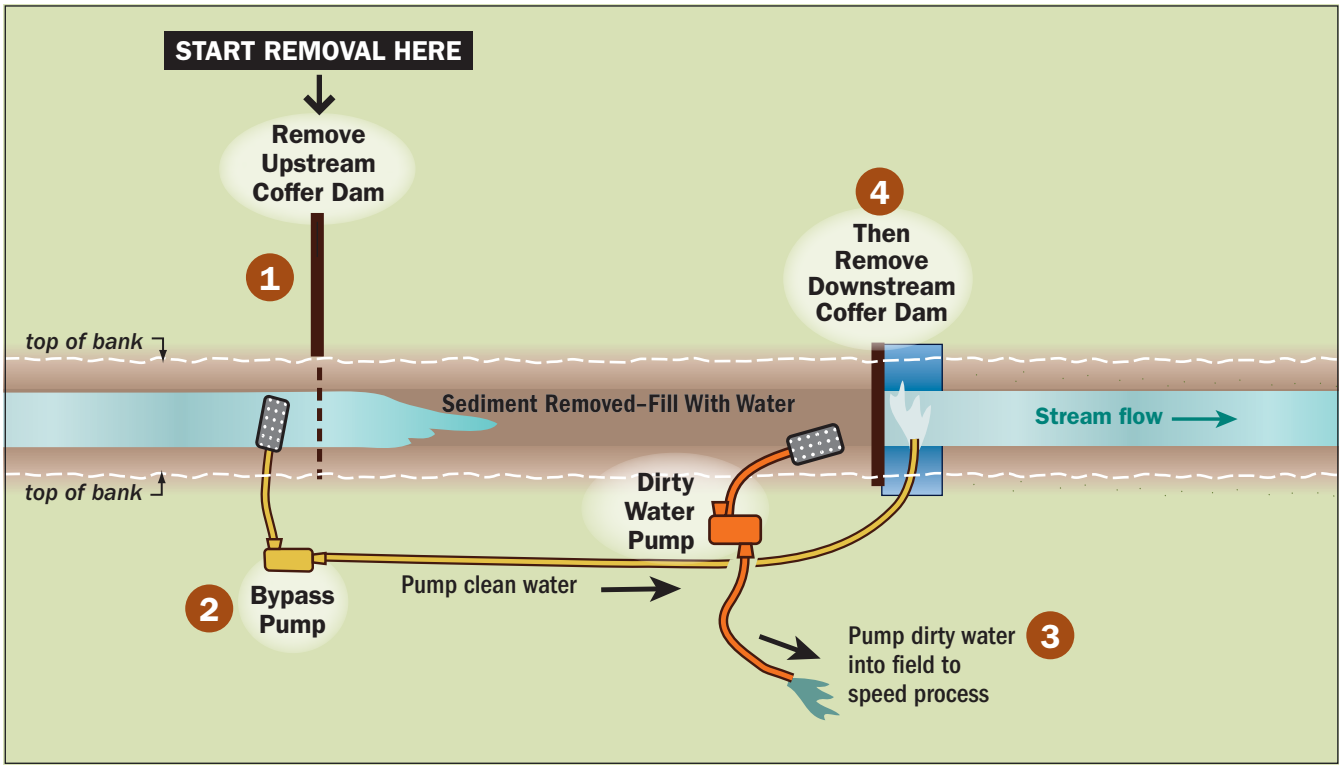
Steel plates are often used for coffer dams because they can be pushed into the soft soil and are easily moved. The bypass pump keeps water flowing in the waterway downstream of the work area.

The downstream coffer dam keeps dirty water in work area separate from clean water in the downstream channel. Here the bypass pump discharge utilizes a five gallon bucket for energy dissipation.

STEPS FOR BYPASS REMOVAL BMPs:

At the end of the work day, the contractor can leave the bypass in place or remove it. If the bypass is left in place, the bypass pump needs to be operated throughout the night so the downstream waterway does not dry out. To remove the bypass, follow these steps:

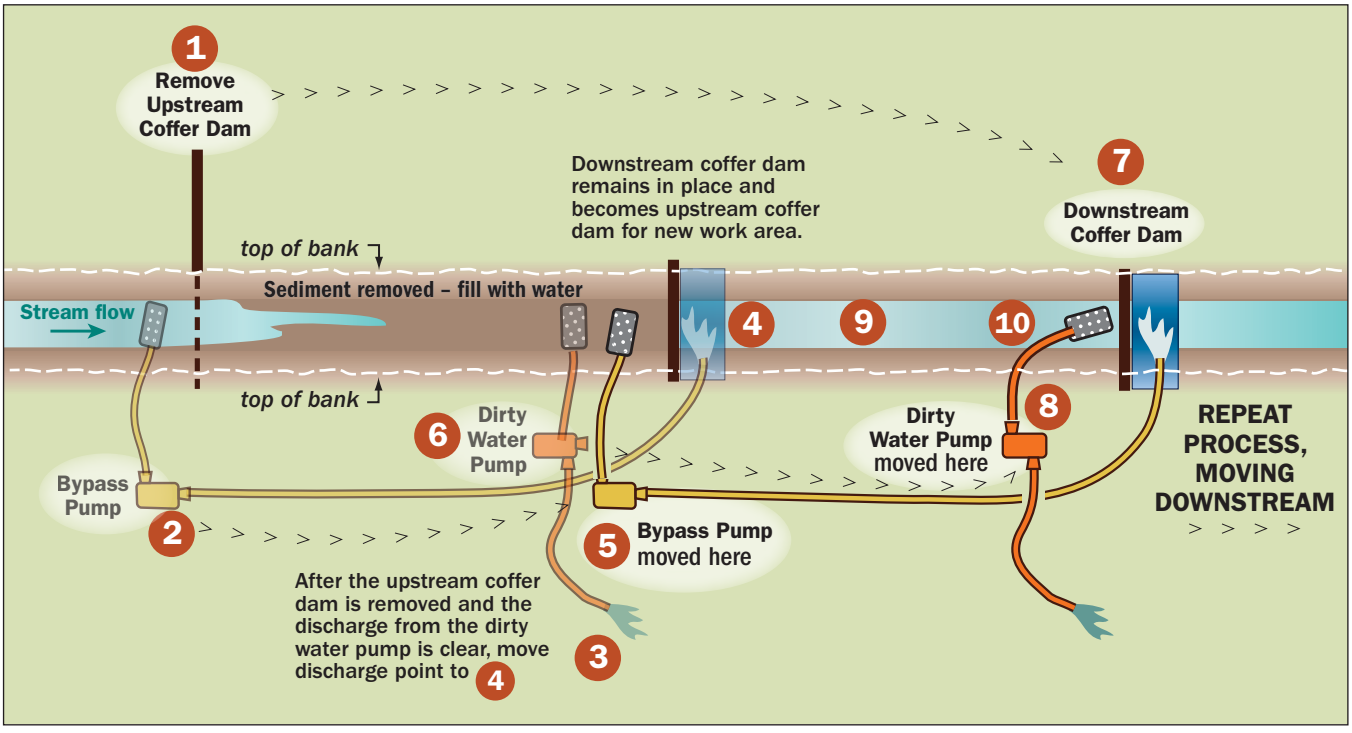
1. Start bypass removal by slowly removing the upstream coffer dam.
2. Reduce the capacity of the bypass pump or cycle its operation to allow the cleaned channel to fill with water while maintaining a continuous flow of water in the downstream waterway.
3. Continue to operate the bypass pump until the water in the work area is clear. The dirty water pump can speed this process by pumping dirty water into the adjoining fields.
4. When the water at the remaining coffer dam is as clean as the water flowing into the cleaned ditch, (confirm with turbidity measurements) slowly remove the remaining coffer dam and turn the pumps off.



STEPS FOR BYPASS LEAPFROGGING

If the work area has been cleaned and the project will continue that day, the bypass will be moved downstream by leapfrogging one coffer dam over the other. To leapfrog a bypass, follow these steps:

1. Start bypass removal by slowly removing the upstream coffer dam.
2. Reduce the capacity of the bypass pump or cycle its operation to allow the cleaned channel to fill with water while maintaining a continuous flow of water in the downstream waterway.
3. Continue to operate the bypass pump until the water in the work area is clear. The dirty water pump can speed this process by pumping dirty water into the adjoining fields.
4. When the water upstream of the coffer dam is clear move the discharge of the dirty water pump into the channel just downstream of the remaining coffer dam.
5. Move the bypass pump down to the remaining coffer dam and start pumping to the end of the next work area.
6. When the bypass pump is setup and operating again, turn off the dirty water pump.
7. Install the downstream coffer dam.
8. Set up the dirty water pump and start pumping the water in the channel between the coffer dams into the adjoining fields at a location where it cannot flow back into the channel prior to having the suspended sediments removed.
9. The fish salvage crew will catch stranded as the water level drops and relocate them outside of the project.
10. Begin sediment removal at downstream end of construction area.



Culvert Replacement

Damaged culverts can restrict flow and be safety hazards. Culverts can be replaced as part of an ADAP project. New culverts must be sized according to Washington Department of Fish and Wildlife guidelines (Google "design of road culverts for fish passage"). The ADAP engineer will provide the data needed to determine the size of the new culvert. See Appendix G for more information.

This damaged culvert inlet results in the culvert having only about 25% of its original capacity.

This damaged culvert does not obstruct flow as much as the damaged inlet shown above, but this culvert could collapse if the farm road is used by heavy farm equipment.

Beaver Dam Removal

Beaver have re-colonized many parts of their historic range. Beaver build dams for protection. The high water behind the dam creates a submerged entrance into their den that prevents predators from entering. The high water also allows them to reach their food while staying in or near the water.

Removing a beaver dam, or even trapping beaver, should be considered a temporary solution. Typically, a beaver will rebuild a removed dam within a couple days and will continue to rebuild it until it is easier to build it somewhere else (i.e. how far they have to haul the building materials). If beaver are removed from the area by trapping, a new generation of beaver will likely re-occupy the area within 18-36 months.

See Appendix F for more information.

(Above) Removing a beaver dam requires repeated notching of the dam to lower the water level (but not flood downstream properties), removing the part of the dam above the water level, then repeating the process.

(Right) A potato fork is the best tool for removing a beaver dam by hand.

(Left) Sometimes the best, and cheapest, long term solution is to live with beaver by utilizing beaver deceivers and pond levelers.

Phase 3.
Post-Construction Management Practices

This chapter focuses on the short and long term stabilization of the waterway. Short term stabilization is achieved with erosion control BMPs that reduce the amount of sediment that flows or falls into the recently cleaned waterway. Long term stabilization is achieved by planting native plants on the banks of the waterway. The Washington Department of Fish and Wildlife has published "Integrated Streambank Protection Guidelines" and the King County Surface Water Design manual also provides detail on this subject. See Appendices H and I for more information.

Spread grass seed and straw on all disturbed areas above the waterline. Minimizing disturbed areas during construction can reduce erosion control costs.

Integration of erosion control (jute fabric) and a weed barrier allowed this property owner to eliminate the grass seed and straw cover that is required.

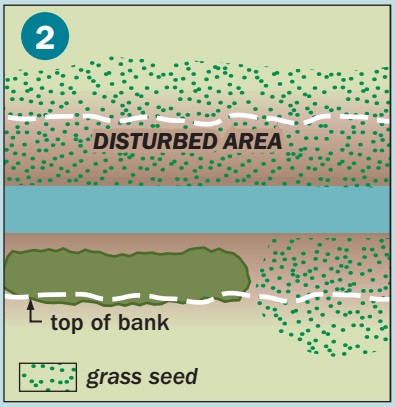
Planting tubes can protect plants when weed whacking will be required (and reduce overall costs). They also protect plants from animals.

Erosion Control

Minimize the area of disturbed soil over the course of the project. **Undisturbed areas can reduce the cost of site revegetation.** See Appendix H for more information.

1. Leave sediment barriers in place at the downstream end of the channel.

2. Spread native grass seed on all exposed areas above the water surface including exposed areas beyond the top of the bank where water can flow into the waterway, exclude farm roads and crop areas. Water seeded areas as needed until grass is established.

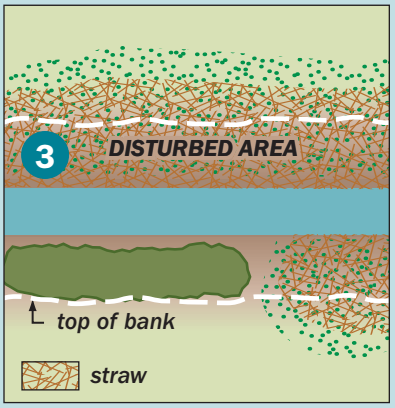


3. Place ½”-1” of straw, mulch or similar biodegradable product over grass seed from the water surface to the top of the bank.

4. Place a 3 ft. wide strip of jute fabric over the straw starting at the water surface.

   A) If installation occurs before September 1, the straw or mulch covering above the jute fabric is not needed but may still be included to reduce irrigation needs until grass is established.

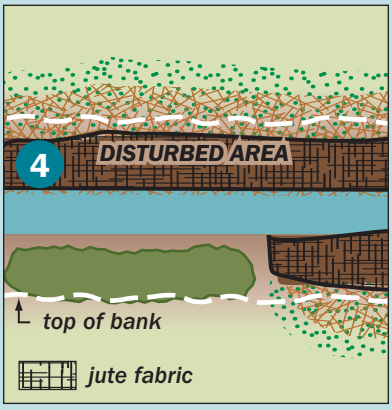
   B) If grass seed is not spread before October 1, extend jute fabric to the top of the bank with the higher row of jute fabric overlapping on top of the lower row by one foot. A commercially available erosion control blanket or mat (Google “erosion control blanket” or “erosion control mat) may be used in place of the straw and jute fabric.



   Note: For fields that are subject to flooding, extend the jute fabric or erosion control blanket to the top of the bank for all low areas in the banks where water will flow back into the channel as flood waters recede.

   All exposed areas above the high water mark can be hydroseeded in lieu of spreading grass seed, straw, and jute fabric.

5. Inspect erosion control measures after significant rainfall. If erosion control measures are not preventing erosion and the eroded material is entering the channel, repair the existing erosion control measures and add additional erosion control BMPs, as needed.



6. If weed fabric is used for planting, no grass seed, straw or jute fabric is required for areas covered by weed fabric (see middle photo, page 21).

7. Remove sediment collected above any sediment barrier still in place, then remove the barriers.

Revegetation

Overview

Vegetation on the banks of a waterway stabilizes the soil, reduces the frequency of future maintenance, and creates better habitat for aquatic species. The grass planted for erosion control provides short term stabilization of disturbed areas; whereas planting trees and/or shrubs provides long term stabilization, shade to lower water temperature, and cover for aquatic species. Protecting existing native vegetation during the construction phase of the project minimizes the costs and planting. See Appendix I for more information.

Trees/Shrubs for Waterway Planting by Group

COMMON NAME	SCIENTIFIC NAME	MATURE HEIGHT (FT.)	MATURE WIDTH (FT.)
Group 1			
Black cottonwood	*Populus trichocarpa*	160	40
Pacific willow	*Salix lasiandra*	40	25
Red alder	*Alnus rubra*	120	30
Red osier dogwood	*Cornus sericea*	15	10
Scouler willow	*Salix scouleriana*	30	30
Sitka willow	*Salix sitchensis*	30	23
Group 2			
Beaked hazelnut	*Corylus cornata var. californica*	20	10
Bitter cherry	*Prunus emarginata*	30	25
Black twinberry	*Lonicera involucrata*	9	6
Nootka rose	*Rosa nutkana*	10	5
Oregon ash	*Fraxinus latifolia*	70	40
Pacific crabapple	*Malus fusca*	40	20
Pacific ninebark	*Physocarpus capitatus*	13	10
Red elderberry	*Sambucus racemosa*	15	10
Sitka spruce	*Picea sitchensis*	200	22
Vine maple	*Acer circinatum*	25	12
Group 3 (Limited to 5% of total plants)			
Salmonberry	*Rubus spectabilis*	10	6
Snowberry	*Symphoricarpos albus*	5	3

A general planting plan would have at least 60% of plants in the row closest to the water come from Group 1, of which at least 30% are willow. Additional plants and rows could come from any group as long as no more than 5% come from Group 3.

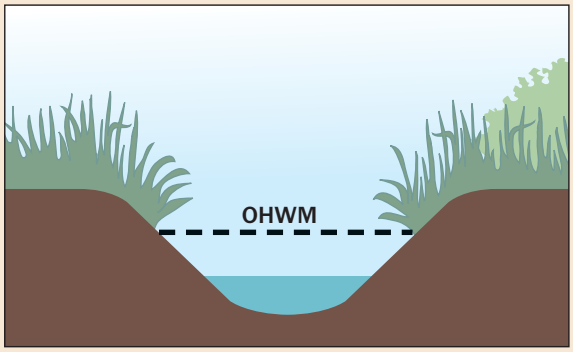
The actual planting plan should take into account the desired long term character of the plants and the time and effort required to allow the plants to outcompete undesirable vegetation.

The first row of plants should be planted above the ordinary high water mark to keep them out of the water column and give them the best chance at survival.

Ordinary High Water Mark (OHWM):

That mark on all lakes, streams, and tidal water where the presence and action of waters are so common and usual, and so long continued in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland. The level of this mark is determined from an examination of the bed and banks.

If the ordinary high water mark is not discernible, consult the ADAP engineer.



Minimum Planting Requirements by Waterway Classification

- Planting requirements are based on the waterway classification system.
- If fish presence is significantly higher or lower during construction than that expected by the watercourse classification, the classification and hence planting requirements may be updated.
- Below is a matrix of planting requirements. Property owners may propose alternate planting requirements but they will not receive streamlined review by the Washington State Department of Fish and Wildlife and may not qualify for the cost share agreement.
- Use only native plant species. Ornamental or hybrid species should not be used.
- Planting additional rows of native trees and shrubs is encouraged (but not required) and will be included in the cost share agreement up to the cost share limit.
- Plants shall be spaced 3 feet on center.
- Rows shall be 3 feet apart and offset from adjoining rows.

Accepted methods of planting are live staking and container or bare root planting. See Appendix I for detailed planting directions.

REQUIRED PLANTINGS BY WATERWAY CLASS

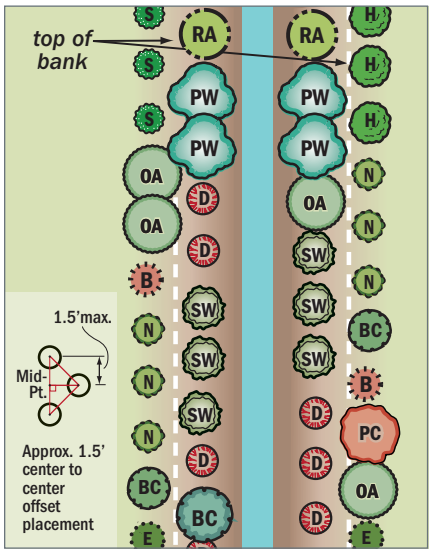
WATERWAY CLASS	High	Moderate	Low
Natural*	Not applicable	Not applicable	Not applicable
Modified	3 rows of native trees/shrubs on each side of the waterway.	2 rows of native trees/ shrubs on each side of the waterway.	2 row of native trees/ shrubs on each side of the waterway.
Artificial	2 rows of native trees/shrubs on each side of the waterway.	1 row of native trees/ shrubs on each side of the waterway.	No plantings required but recommended to control reed canary grass and shade waterway.

** Natural channels are not included in the streamlined ADAP.*

TREES/SHRUBS FOR WATERWAY PLANTING BY HEIGHT

SYMBOL	COMMON NAME	MATURE HEIGHT (FT.)	SYMBOL	COMMON NAME	MATURE HEIGHT (FT.)	SYMBOL	COMMON NAME	MATURE HEIGHT (FT.)
Under 15 Feet			**Between 15-30 Feet**			**Over 30 Feet**		
S	Snowberry	*5*	**E**	Red elderberry	*15*	**PW**	Pacific willow	*40*
T	Black twinberry	*9*	**D**	Red osier dogwood	*15*	**PC**	Pacific crabapple	*40*
B	Salmonberry	*10*	**H**	Beaked hazelnut	*20*	**OA**	Oregon ash	*70*
R	Nootka rose	*10*	**VM**	Vine maple	*25*	**RA**	Red alder	*120*
N	Pacific ninebark	*13*	**BC**	Bitter cherry	*30*	**BC**	Black cottonwood	*160*
			SC	Scouler willow	*30*	**SS**	Sitka spruce	*200*

Sample Planting Plans



General Planting Plan:

Advantages:

- Less susceptible to any single pest or disease
- Diverse and natural riparian environment
- Multi-story growth produces densest canopy
- Provides better wildlife habitat

Disadvantages:

- Height may grow to be 30+ feet tall, if shading adjacent fields is a concern.
- More maintenance required to establish slower growing plants

See Appendix L for more detail.

Willow Planting Plan

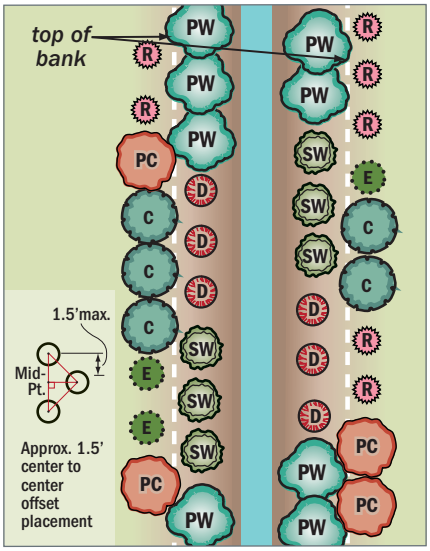
Advantages:

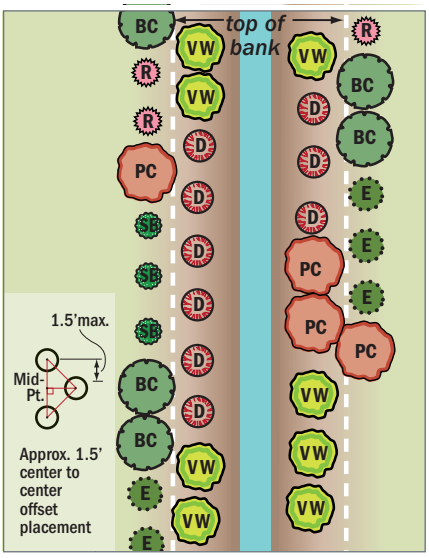
- Live staking easiest and cheapest way to plant
- Generally can out-compete reed canary grass in one year, minimizing the need for weed fabric or weed whacking
- Future waterway maintenance is easier and cheaper because willows can be cut almost to the ground and will quickly regrow
- Higher survivorship means less replanting to achieve planting goals

Disadvantages:

- Height may grow to be 30+ feet tall, if shading adjacent fields is a concern
- Perceived to attract beaver
- All willow makes plants susceptible to willow weevil infestation

See Appendix M for more detail.





No Willow Planting Plan

Advantages:

- Generally lower growing, if shading adjacent fields is a concern
- Denser growth
- Not as attractive to beavers

Disadvantages:

- Increased cost because weed fabric is required or reed canary grass must be mowed several times each year for 2-4 years
- Survivorship often lower than willows
- Higher planting costs because generally cannot use live stakes

See Appendix N for more detail.

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King Conservation District

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www.kingcounty.gov/ag

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