



Component VII

Channel Modification

Assessment

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Component VII

Channel Modification Assessment

INTRODUCTION

In-channel structures and activities such as damming and dredging or filling hinder fish migration, alter the physical character of streams, and change the composition of stream **biota**.¹ The degree of impact to habitat will depend on the type of channel and the type and magnitude of channel modification. Channels are dynamic systems that modify themselves in response to changes in physical watershed features regardless of human involvement. This section identifies how human activities have directly changed channel **morphology** and aquatic habitat. This information is then synthesized with information from the other components to assess overall watershed health and function.

In this portion of the watershed assessment, you will map and categorize current channel modifications and incorporate historic channel modification information from the Historic Conditions Assessment component. During the final part of this assessment, you will overlay the channel modification map with the **Channel Habitat Type** (CHT) Map (from the Channel Habitat Type Classification component) to identify which CHTs have been directly impacted by these activities.

Critical Questions

1. Where are channel modifications located?
2. Where are historic channel disturbances, such as dam failures, **splash damming**, hydraulic mining, and **stream cleaning**, located?
3. What CHTs have been impacted by channel modification?
4. What are the types and relative magnitude of past and current channel modifications?

Assumptions

- Channel modifications and historic land use and in-channel activities may have altered the quality and/or quantity of aquatic resources in the basin.
- In the absence of documentation on pre-European settlement conditions, the impact to aquatic resources from the channel modification can be inferred from the type of modification or historic disturbance **and** the CHT affected.
- Channel disturbances, such as channel widening, extensive bank erosion, or large gravel deposits, with no apparent adjacent cause, are response indicators of changes in upstream channel input factors that may or may not be related to human activities; channels do modify their form through natural disturbance events. Conversely, channel **gradient** can be used to

¹ Terms that appear in bold italic throughout the text are defined in the Glossary at the end of this component.

predict zones of potential channel impacts due to declining transport ability and sediment deposition.

Materials Needed

- 7.5-minute US Geological Survey (USGS) topographic maps of the watershed (from the Start-Up and Identification of Watershed Issues component)
- Project base map (from the Start-Up and Identification of Watershed Issues component)
- Sharp pencil, colored pencils, thin permanent markers (optional: colored adhesive dots)
- USGS topographic map symbol legend
- Data and information on channel modification (see Step 1 below for list of potential sources)
- Federal Emergency Management Agency (FEMA) floodplain maps (if available)
- National Wetland Inventory (NWI) maps
- A map wheel (or an engineer's ruler with inches marked in 10ths so you can easily enter measurements into a calculator will work if you measure carefully)
- Aerial photos of the basin (from the Start-Up and Identification of Watershed Issues component)

Necessary Skills

The minimum skills necessary to produce the Channel Modification Map include (1) the ability to read and use topographic maps, (2) the ability to accurately transfer information between maps of different scales, and (3) an ability to search for and compile information from many sources. The ability to use aerial photographs will aid this task, but is not required.

Final Products of the Channel Modification Assessment

1. Channel Modification Map (CM-1)
2. Channel Modification Inventory (Form CM-1) corresponding to numbered sites on the map
3. Channel Modification Summary (Form CM-2), a summary by subwatershed of the amount of channel modified by each activity
4. Confidence Evaluation (Form CM-3) assessing your confidence in the accuracy and comprehensiveness of the overall mapping

CHANNEL MODIFICATION MAPPING PROCEDURES

Step 1: Gather Available Information

Ideally, you would obtain the Historical Channel Modifications Map (from the Historical Conditions Assessment component) showing locations where historic activities affect stream channels shown. It is likely, however, that this map will be in preparation and not available at the onset of this task. If this is the case, you will prepare a map of current channel modifications and combine that map with the historic impacts map at a later date. To begin mapping, obtain a copy of the project base map. It is also possible to do the initial mapping on topographic maps, or on a Mylar overlay of the base map or topographic maps.

A number of sources are available to gather information concerning current channel modifications, such as the following.

Topographic Maps

Many channel modifications are shown on topographic maps. Most notably are **impoundments**, dikes, roads along streams, and channel straightening. Structures in or immediately adjacent to the channel may also be apparent. Note the date of the map and the presence of updated features, usually shown in a violet color.

Aerial Photographs

Depending on the quality of the photos and the skill of the reviewer, aerials can be one of the most useful tools in evaluating channel modifications and their potential impacts to the channel and aquatic habitat. Many modifications are quite obvious on photos, and are readily identified by people with limited photo interpretation experience. Again, noting the date and scale of the photos will aid in assessing the condition of the channel and the modification. Because time will be limited, start by reviewing the photos of the largest channels in the watershed. Modifications to smaller channels may not be visible on the photos.

Agency Records and Personnel

While not all of the agencies listed in Table 1 will have information concerning channel modifications, contact any agency that has jurisdiction over waterways and **riparian areas** in your watershed. It is prudent to make inquiries as early as possible, because information may take some time to reach you.

As a start, two agencies, the US Army Corps of Engineers (Corps) and the Oregon Department of State Lands (DSL), have jurisdiction over activities in “**Waters of the State**,” including wetlands. The Portland office of the Corps (503-808-5150) can be contacted concerning the federal Clean Water Act Section 404 permits dealing with fills and in-stream structures. Contact the Salem office of DSL (503-378-3805) concerning Fill and Removal permits in the watershed.

Other agencies such as the Oregon Department of Fish and Wildlife (ODFW), County Public Works, Oregon Department of Transportation (road maintenance issues), diking districts, the US Bureau of Land Management (BLM), or local port authorities may also have useful information.

In addition, NWI maps display some channel modifications. Consult with the Riparian/Wetland Assessment component analyst concerning the date and accuracy of the maps.

Floodplain Mapping

There are two purposes in identifying the location of the **100-year floodplain** within the watershed. The first is to identify areas where channel diking and levees have disconnected the river from its floodplain. The second is to provide information for the decision process regarding flood protection versus restoration potential that will follow the completion of the Watershed Condition Evaluation component. Recognize that determining the 100-year floodplain for many streams may be unnecessary (confined channels in narrow valleys). Field verification and assistance from professionals may be needed if extensive floodplains and/or flooding issues are important in the basin.

FEMA floodplain maps are available for most large rivers as a requirement for qualification of federal flood insurance. They can be ordered directly from FEMA or are available for copying at most county planning or public works departments. Some counties and cities may have funded additional river or stream studies. Check with your local county or city planners to find out what floodplain mapping they use to best reflect potential flooding conditions. It is important to note that many floodplain maps are outdated or contain erroneous information. Verify to the extent possible the accuracy of the mapping with knowledgeable personnel. If floodplains are extensive, it may be worthwhile to transfer the location of the floodplain to the Channel Modification Map.

Land Owners/Field Work

Land owners may be a valuable source for information concerning activities in or near the channel. Inventories of activities may be available in basins with large industrial land owners such as timber companies. Local residents may also be able to provide information. Obviously, the more time the analyst can spend in the field mapping and assessing the magnitude of any modifications, the higher the quality of the final products.

Step 2: Map Channel Modifications

The following steps apply to mapping all types of channel modifications.

1. Investigate all probable and likely sources of information on channel modification activities within your watershed.
2. Draw each modification site onto the Channel Modification Map using the appropriate number to tie to Form CM-1 containing information about the activity. Where more than one modification activity overlaps, draw both mapping symbols. Where you are unsure of the exact beginning or end of a feature, put a question mark at the beginning and/or end of the map symbol.
3. Mark small features with an X or brightly colored dot.
4. Label each channel modification/disturbance site with a number. Fill out the first three columns on the Channel Modification Inventory (Form CM-1) for each site.

5. Create a map legend. If appropriate, include the 100-year floodplain and all numbers/symbols used to depict the various channel modifications or disturbance sites. Sign and date the map.

Step 2a: Map Current Modifications

Table 1 lists potential channel modification activities that may be present in your watershed and likely sources of information. The list of potential channel modification activities is not inclusive. When inquiring about the presence of projects or past activities, be sure to ask about any other activities that may have taken place.

Table 1. Potential channel modifications.

Channel Modification Activity	Sources of Information
Hydroelectric and irrigation dams	Topo maps, Corps, Bureau of Reclamation
Reservoirs and artificial impoundments	Same as above, NWI maps
Small agricultural impoundments, cattle ponds, fire ponds	Topo maps, irrigation districts, local farmers and ranchers, forestry landowners, fire-protection district maps, NWI maps
Dikes, levees (usually for flood control)	County engineering or public works department, Corps, local diking districts, NWI maps
Channelization (channel straightening, hardening, or relocation)	County/city planning or public works departments, local conservation districts, comparisons with historic maps
Dredged channels	Port authorities, Corps, county engineering department
Stream-bank protection (<i>riprap</i> , pilings, bulkheads)	Local and state hydraulic permit officials, county engineering or public works departments, Corps, DSL permits
Built-up areas in floodplains, in/near estuaries, wetlands, and channels	USGS topo maps, comparisons with maps or photos predating the fill (assessor's photos), engineering reports on fill materials, project environmental impact statements
Roads next to streams	County road maps; ODFW, US Forest Service (USFS), BLM and other forestry road maps; fire-protection district maps
Extensive fill associated with road crossings (~250+ feet)	County road maps; ODFW, USFS, BLM and other forestry road maps; fire-protection district maps
Tide gates	Local officials, residents, diking and water control districts
Water withdrawals	State Water Resource Department, State Department of Environmental Quality 303(d) (1)-listed streams, local officials
Push-up dams	State Water Resource Department, local officials
Sand and gravel mining in/near channels, <i>tailings</i> deposits	DOGAMI (Department of Geology and Mineral Industries), county land use/zoning, DSL permits

Be aware that interpretation of some channel modifications will be a judgment call. For example, roads are frequently located in the flat-lying valleys and encroach into the floodplains of channels. To protect the road from inundation and erosion, roadbeds are elevated and the banks of streams often armored. Such roads will effectively act as dikes or levees, preventing the stream from meandering and eliminating refuge sites for fish during flood flows. You will need to exercise some judgment concerning whether the road does potentially infringe into the channel or floodplain. If the road falls within the FEMA floodplain or the floodplain clearly stops artificially at the base of the road grade, then the road should be mapped.

Step 2b: Incorporate Historic Conditions Information

The final products for the Channel Modification Assessment component will meld the information from the Historical Conditions component regarding channel modifications with identified current modifications. As such, it is important that there be a high degree of coordination between the people performing these two assessments. While it is important that the final products display both sets of information, the precise timing regarding merging of information is not critical.

It may be difficult to categorize some activities as either historic or current. For example, old dike systems that are sporadically maintained or expanded could be considered either a historic or current modification. Another example may be a 100-year-old road that affects channel migration patterns. In general, consider historic those activities that are not ongoing or maintained. Often, these activities will have ceased over 30 years ago.

It is not critical whether a specific modification be deemed historic or current; only that the activity be documented and some assessment be made as to the type and magnitude of channel impact resulting from the activity.

The product of this portion of the assessment will be a map displaying channel modifications (Map CM-1), and Form CM 1 with sites cross-referenced to the map.

Step 3: Evaluate Impact of Modifications

Once the location and type of channel modifications (both historic and current) have been inventoried, you can make an assessment of their impact on channel conditions. The goal is to identify the type of impact and assign a relative degree of impact. This task may involve some judgment calls, but your focus is to identify those modifications that have the greatest impact on channel characteristics and aquatic habitat. Table 2 lists channel modifications and their probable impact. The presented information is meant as a guide, and not all possible impacts can be identified and listed. You are encouraged to query knowledgeable fish biologists as to possible impact type and degree.

In order to identify a general degree or magnitude of impact, you need to assign each identified channel modification activity a rating of low, moderate, or high. Although subjective, this rating identifies those activities most likely to affect channel characteristics and aquatic habitat. Obviously, field verification of modifications greatly increases the accuracy of the impact assessment. The following guidelines will help you for assign ratings. Consider the type of impact, the geographic extent, age, and longevity of the modification when assigning a degree. Enter the type and degree of impact data for each channel modification on Form CM-1.

- **Low**
 - Channel impacts are not readily apparent.
 - Impacts likely affect only a small ($\sim < 1\%$ of channel or wetland) area.
 - Channel characteristics such as pattern, width, substrate type, bank erosion, pool features, and large wood distribution are largely unchanged.
- **Moderate**
 - Impacts are localized but apparent.
 - Changes to channel characteristics such as pattern, width, substrate type, bank erosion, pool features, and large wood distribution are detectable but not obvious.
- **High**
 - Impacts are obvious: gross changes in channel characteristics such as pattern, width, substrate, and bank erosion.
 - A significant length of the channel is affected.
 - A significant portion of a wetland is affected (drained, filled).

Step 4: Identify Affected CHTs

Overlay the Channel Modification Map on the Channel Habitat Type Map to determine which habitat types have been most affected. Enter this information in Form CM-1. Summarize the length of channel affected within each sub-basin and enter this information into Form CM-2.

Step 5: Evaluate Confidence in the Assessment

You can evaluate the strength of your channel modification assessment by considering the resources used, whether information was field-verified, and so on. Form CM-3 provides criteria for the evaluation. If the type or quality of information used to map the watershed differs significantly from area to area, fill out a form that evaluates each general area.

Table 2. Probable impacts from channel modifications.

Channel Modification Activity	Probable Impact
Hydroelectric and irrigation dams	Migration barrier, loss of spawning and rearing habitat, non-native fish introduction
Reservoirs and artificial impoundments	Flow alteration, loss of spawning gravels
Small agricultural impoundments, cattle ponds, fire ponds	Migration barrier, loss of spawning and rearing habitat, non-native fish introduction, water quality impacts
Dikes, levees (usually for flood control)	Loss of side-channels and floodplain function, decrease in channel length, and reduction of habitat complexity
Channelization (channel straightening, hardening, or relocation)	Reduction in key habitat features such as pools and sorted gravel
Dredged channels	Decrease of habitat complexity
Stream-bank protection (riprap, pilings, bulkheads)	Decrease in lateral scour pools; likely to incite bank erosion downstream
Built-up areas in floodplains, in/near estuaries, wetlands, and channels	Loss of side-channels, flood attenuation, and food-chain support
Tide gates	Loss of off-channel rearing areas and food-chain support
Roads next to streams	Loss of side-channels, lateral pools, and riparian function
Extensive fill associated with road crossings (~250+ feet)	Loss of habitat complexity, downstream erosion
Push-up dams	Migration barrier, habitat loss, flow alteration
Sand and gravel mining in/near channels, tailings deposits	Pool filling, decreased habitat complexity

GLOSSARY

100-year floodplain: That area adjacent to the channel which has a 1 in 100 chance of being flooded in any given year.

biota: Living matter.

channel confinement: Ratio of bankfull channel width to width of modern floodplain. Modern floodplain is the flood-prone area and may correspond to the 100-year floodplain. Typically, channel confinement is a description of how much a channel can move within its valley before it is stopped by a hill slope or terrace.

Channel Habitat Types (CHT): Groups of stream channels with similar gradient, **channel pattern**, and **confinement**. Channels within a particular group are expected to respond similarly to changes in environmental factors that influence channel conditions. In this process, CHTs are used to organize information at a scale relevant to aquatic resources, and lead to identification of restoration opportunities.

channel pattern: Description of how a stream channel looks as it flows down its valley (for example, braided channel or meandering channel).

gradient: Channel gradient is the slope of the channel bed along a line connecting the deepest points (thalweg) of the channel.

impoundment: A structure meant to dam or hold back water.

morphology: A branch of science dealing with the structure and form of objects. Geomorphology as applied to stream channels refers to the nature of landforms and topographic features.

riparian area: The area adjacent to the stream channel that interacts and is dependent on the stream for biologic integrity.

riprap: Material (usually boulders) placed along a stream bank to prevent erosion of the bank.

splash damming: Historical practice where a small dam was built across a stream to impound water and logs. The dam was then removed (usually with explosives) to release the impounded logs and water, causing scour downstream.

stream cleaning: The removal of large wood or fine organic matter (i.e., branches, twigs, leaves, etc.) from stream channels. Historically, this practice was used to remove debris jams that were thought to block fish passage, or to remove fine organic matter that was thought to cause water quality problems such as reducing aquatic oxygen levels. Because stream cleaning was found to damage fish habitat, it is currently not a common practice.

tailings: Washed or milled rock that has been processed for ore removal.

Waters of the State: Those water bodies over which the State of Oregon has regulatory authority.

Appendix VII - A
Blank Forms

Form CM-2: Channel Modification Summary

Watershed:

Page ____ **of** ____

Name:

Date:

Sub-basin	Miles of Channel Modified					Total Miles
	Dredging	Diking	Road Along Stream	Riprap	Etc.	
Total Miles						

Form CM-3: Confidence Evaluation in Channel Modification Assessment

Watershed:

Name of Mapper(s):

Technical expertise or relevant experience:

Resources used:

- | | |
|--|---|
| <input type="checkbox"/> Topographic maps | <input type="checkbox"/> Field verification |
| <input type="checkbox"/> ODFW | <input type="checkbox"/> Newspaper archives |
| <input type="checkbox"/> FEMA flood maps/county maps | <input type="checkbox"/> Army Corp. Engineers personnel/documents |
| <input type="checkbox"/> Local irrigation/diking district | <input type="checkbox"/> Forestry landowners (all / some) |
| <input type="checkbox"/> Historical records | <input type="checkbox"/> Long-time residents, old-timers |
| <input type="checkbox"/> Local officials/records | <input type="checkbox"/> Bureau of Rec. personnel/documents |
| <input type="checkbox"/> Road maps: county/ODF/USFS/BLM/forestry landowners/fire-protection district | <input type="checkbox"/> County/city zoning maps |
| <input type="checkbox"/> DOGMI mining records | <input type="checkbox"/> Port authorities |
| <input type="checkbox"/> Local knowledge/personal knowledge | |
| <input type="checkbox"/> Others (list) | |

Confidence in channel modification mapping:

- Low to moderate:** Unsure of procedures and/or used minimal resources; no field verification.
- Moderate:** Understood and followed procedures; used at least one resource for all categories mapped; no field verification; suspect some modification activities not known.
- Moderate to high:** Understood and followed procedures; used many resources for mapping; some field verification; suspect some modification activities not known.
- High:** Used many resources; historical activities in area well-documented; field-verified all questionable locations; suspect few modification activities not known.
- If none of the above** categories fits, describe your own confidence level and rationale: