Appendix III-A Descriptions of Channel Habitat Types

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Appendix III-A
Descriptions of Channel Habitat Types

CHANNEL HABITAT TYPING BACKGROUND

Stream classification systems can be organized on different scales within the watershed: from as large as the entire channel network down to individual pools or microhabitats within those pools. The channel types in this classification system are centered in the middle of this hierarchy, and incorporate landscape features such as valley type as well as **stream reach**[1] features such as gradient. The variables selected to describe each channel type remain relatively constant within time scales of concern to land management. The scale is small enough to predict patterns in channel physical characteristics, yet large enough to be identified from topographic maps and limited field work. Table III-A-1 compares attributes of current stream classification methodologies.

Drawing on these existing stream classification systems, we have assigned a basic number of channel types for Oregon streams that we are calling Channel Habitat Types (CHTs). This stream classification system will enable users to make inferences about how land use impacts can alter physical channel form and process and, therefore, fish habitat. Note that the commonly utilized attributes of stream **gradient** and **confinement** are the prime identifying features of any CHT. Additionally, valley shape and stream size may guide assignment of CHTs to a stream system. The intent of this section is not to "reinvent the wheel" concerning stream channel classification, but to adapt existing systems to capture the variability of Oregon's stream channels.

This appendix is patterned after the *Channel Type User Guide Tongass National Forest* (Paustian et al. 1992.) The purpose of this appendix is to provide users with sufficient information to understand the characteristics of each CHT. The information in this appendix is intentionally brief. This appendix is designed to give a picture of channel type characteristics. The information refers to typical channel type conditions, and is intended to summarize the most frequent channel type conditions found in Oregon. Although channel type characteristics are relatively consistent, there will be variability within map units. Therefore, site-specific channel characteristics and management interpretations should be field-verified for project planning.

It is important to remember that CHTs cannot be managed as isolated segments. Stream reaches in one part of a watershed can be affected by activities taking place in a different part of the watershed, either upstream, downstream, or on adjacent land areas.

Finally, the following sections present a channel responsive statement for each CHT. It should be noted that these are general statements, and site-specific parameters such as geology and climate greatly influence the type and magnitude of a channel's response.

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

Table III-A-1. Comparison of basic diagnostic features of key stream channel classification methods.

Basic Stream Classification Diagnostic Features	Frissell et al. 1986, Seg/Reach Systems [1]	Cupp 1989[2]	Paustian et al. 1992[3]	Montgomery & Buffington 1993 Levels II, III, IV	Rosgen 1996 Levels I, II	Moore et al. 1997 ODFW hab. Survey [4]
Valley bottom shape [5]	qualitative	x	x	implied	x	x
Valley bottom slope and/or stream gradient [5]	x	x	x	x	x	x
Side-slope gradient [5]	qualitative	x	x			x
Incision depth or entrenchment			x		x	x
Bankfull width			x		x	x
Active channel width/ depth ratio					x	
Valley bottom width: active channel width ratio		x		qualitative confinement	uses entrenchment	x
Position in the drainage network, stream order[6], or drainage area [5]	x	x	x	implied		x
Bed features, channel morphology	x			x	Inferred	x
Plan view channel pattern [5]	x	x	x		x	unconstrained channels only
Stream-adjacent landforms		x				x
Other criteria	lithology, riparian veg., soil assocs., bank composition		dominant substrate, bank composition	sediment supply/sources, substrate; defines reach types	substrate	substrate, bank composition, riparian data, LWD, other
Initial delineation		maps	aerial photographs		I-remote sensing, existing inventories; II-field measure-ments	field surveys
Number of basic channel groups [7]		5	9	8	9	habitat unit level

1 Oriented to small mountain streams in forested environments; provides theoretical framework rather than specific categories.
2 Developed for forested lands in Washington State.
3 Developed for Tongass National Forest, Alaska.
4 Method is more of a habitat survey than channel classification system.
5 Those criteria identifiable from maps.
6 Montgomery and Buffington believe stream order inappropriate as a foundation for geomorphic channel classification due to differences in mapping detail, drainage density differences between basins, discharge, and landscape controlling factors.
7 Basic Channel Groups:
F - flat cross-section profile, M - moderate gradient sideslopes, V - V-shaped valleys, U - U-shaped valleys, H - headwater tributaries (Cupp 1989), ES - estuarine, PA - palustrine, FP - floodplain, GO - glacial outwash, AF - alluvial fan, LC - large contained, MM - moderate gradient mixed control, MC - moderate gradient contained, HC - high gradient contained (Paustian et al. 1992) braided, regime, pool-riffle, plane bed, step-pool, cascade, bedrock, colluvial (Montgomery and Buffington 1993)

The general format of each CHT description is as follows:

TITLE

Each description begins with the naming convention that includes the CHT name and the channel mapping symbol that can be used as a shorthand name for a given CHT. Following the title is a narrative description of the typical location and physical characteristics of the CHT.

A drawing and photo of the physical setting for the CHT, and an illustrated example from a topographic map, will be included in each description.

CHANNEL ATTRIBUTES

Stream gradient
Valley shape
Channel pattern
Channel confinement
Position in drainage
Dominant substrate

CHANNEL RESPONSIVENESS

This section presents information concerning the general responsiveness of the channel to alterations in the supply of sediment, wood, and high flows. Relative ratings are discussed based on the magnitude of the potential **morphologic response** of the channel. Refer to Table 4 in the Channel Habitat Type Assessment for a description of the low, moderate, and high ratings. Obviously, the discussions dealing with **large woody debris** (LWD) are pertinent to coastal and mountainous regions where wood is available. In eastern Oregon, many channels of the Columbia and Snake River plateau are naturally devoid of wood, or have a very limited supply. In these regions, wood will not be a major influence on the physical characteristics of the channel.

Large Woody Debris

This section discusses the importance of large wood for maintaining stream channel structure and habitat diversity.

Fine Sediment

This section evaluates the potential impacts, locations, and duration of fine-sediment inputs to this CHT.

Coarse Sediment

This section evaluates the potential impacts and duration of coarse-sediment inputs to this CHT.

Peak Flows

This section evaluates the potential impacts and duration of changes in peak flows to this CHT.

RIPARIAN ENHANCEMENT OPPORTUNITIES

This section presents management concerns for in-stream and near-stream management activities, as well as **riparian** management opportunities.

The following section begins the CHT descriptions.

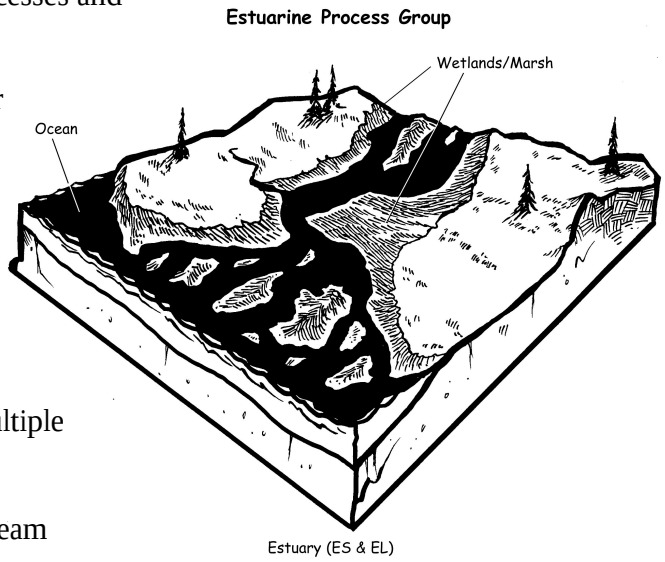
SMALL ESTUARINE CHANNEL
ES

These channels are found at the mouths of drainages along outer coastal beaches or bays. They are **intertidal** streams that occur exclusively within **estuary** landforms, usually draining a small, high-relief or moderate-sized watershed. They are associated with saltwater marshes, meadows, **mudflats**, and **deltas**.

These streams are predominantly sediment depositional channels associated with low-relief coastal landforms. Stream energy is low due to nearly flat gradients, with substrate material consisting mainly of small gravels, sand, and silt. Channel morphology is strongly influenced by tidal stage. Fine-grained stream banks are highly sensitive to erosion. Beach erosion processes often have a dominant influence on deposition and erosion in the outer coastal estuarine streams.

The original boundary of an estuary may be difficult to determine due to modifications associated with marinas, highways, or reclamation. Many coastal estuaries have been delineated through county, state, or municipal planning processes and may include the predevelopment boundaries.

The state has produced an excellent reference for estuaries, particularly as it relates to classification and land use (Oregon Department of Land Conservation and Development 1987).



CHANNEL ATTRIBUTES

Stream gradient:	≤1%
Valley shape:	Broad
Channel pattern:	Sinuous, single, or multiple
Channel confinement:	Unconfined
Oregon stream size:	Small, medium
Position in drainage:	Bottom, mouth of stream
Dominant substrate:	Small gravel, sand

CHANNEL RESPONSIVENESS

These channels are low-energy areas where sediment deposition is a dominant process. While channel sensitivity in estuaries can vary, the unconfined nature of these areas tends to attenuate changes over space and time. Abandonment and reoccupation of **relic channels** commonly occurs, but it may be a slow process.

Large Woody Debris: Moderate

Unless in jams, wood often has limited influence on the overall **morphology** of the channel. Accumulations can be associated with channel shifting. Although wood is often the only roughness element present in these channels, the high sedimentation rate limits pool development and gravel sorting. The primary aquatic habitat role of wood may be refuge cover.

Fine Sediment: Moderate to High

Fine sediment is deposited at a relatively high rate, strongly influencing the arrangement of channels. In most smaller estuaries, an increase in the sediment supply would result in bar formation or reoccupation of relic channels. Localized bank erosion or downcutting could be expected if the sediment supply were to decrease.

ES – Small Estuary

Scale: Half (1:48,000)
Contour Interval: 40 feet

Coarse Sediment: Low to Moderate

Although these channels can be deposition zones for coarse sediment, the delivery rate to estuarine channels is usually low due to sedimentation upstream. In some basins, deposits likely influence channel configuration at the upper end of the estuary.

Peak Flows: Low

Estuarine channels are usually capable of transporting high flows with a minimum of alteration to the primary physical characteristics of the channel. Flows tend to spread out across the valley rather than cause streambed **scour**. Localized bank erosion is expected if new channels are developed.

RIPARIAN ENHANCEMENT OPPORTUNITIES

Many enhancement efforts in estuaries are related to long-term preservation of the area. As these channels harbor unique biologic communities, limiting development is a common strategy. Structural enhancement activities often involve dike breaching or removal to reconnect wetlands or *sloughs*.

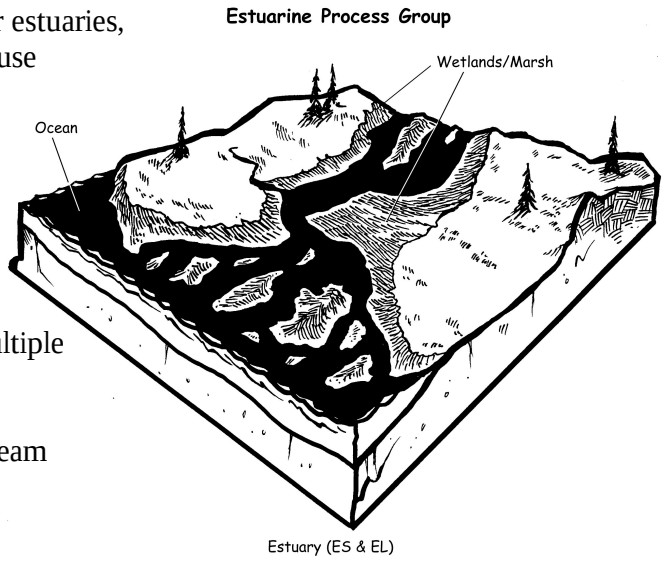
LARGE ESTUARINE CHANNEL
EL

These channels are most commonly found at the mouths of drainages along outer coastal beaches or bays. They are intertidal streams that occur exclusively within estuary landforms, usually draining a high-relief or moderate-sized watershed. They are associated with saltwater marshes, meadows, mudflats, and deltas.

These streams are predominantly depositional channels associated with low-relief coastal landforms; therefore, sediment retention is a dominant process. Stream energy is low due to nearly flat gradients, and substrate material consists mainly of small gravels, sand, and silt. Water flow and depth are strongly influenced by tidal stage. Fine-grained stream banks are highly sensitive to erosion. Beach erosion processes often have a dominant influence on deposition and erosion in the outer coastal estuarine streams.

The original boundary of an estuary may be difficult to determine due to modifications for marinas, highways, or reclamation. Many coastal estuaries will have been delineated through county, state, or municipal planning processes and may include the predevelopment boundaries.

The state has produced an excellent reference for estuaries, particularly as it relates to classification and land use (Oregon Department of Land Conservation and Development 1987).



CHANNEL ATTRIBUTES

Stream gradient:	≤1%
Valley shape:	Broad
Channel pattern:	Sinuous, single, or multiple
Channel confinement:	Unconfined
Oregon stream size:	Large
Position in drainage:	Bottom, mouth of stream
Dominant substrate:	Small gravel, sand

CHANNEL RESPONSIVENESS

These channels are low- to moderate-energy areas where sediment deposition is a dominant process. Although channel sensitivity in estuaries can vary, the unconfined nature of these areas tends to attenuate changes over space and time. Abandonment and reoccupation of relic channels commonly occurs, but it may be a slow process.

Large Woody Debris: Low to Moderate

Unless in jams, wood often has limited influence on the overall morphology of the channel. Accumulations can be associated with channel shifting. Although wood is often the only roughness element present in these channels, the high sedimentation rate limits pool development and gravel sorting. The primary aquatic habitat role of wood may be refuge cover.

Fine Sediment: Moderate to High

Fine sediment is deposited at a relatively high rate, strongly influencing the arrangement of channels. In most smaller estuaries, an increase in the sediment supply would result in bar formation or reoccupation of relic channels. Localized bank erosion or downcutting could be expected if the sediment supply were to decrease.

Coarse Sediment: Low to Moderate

Although these channels can be deposition zones for coarse sediment, the delivery rate to estuarine channels is usually low due to sedimentation upstream. In some basins, deposits likely influence channel configuration at the upper end of the estuary.

EL – Large Estuary

Scale: Full (1:24,000)
Contour Interval: 40 feet

Peak Flows: Low

Estuarine channels are usually capable of transporting high flows with a minimum of alteration to the primary physical characteristics of the channel. Flows tend to spread out across the valley rather than cause streambed scour. Localized bank erosion is expected if new channels are developed.

RIPARIAN ENHANCEMENT OPPORTUNITIES

Many enhancement efforts in estuaries are related to long-term preservation of

the area. As these channels harbor unique biologic communities, limiting development is a common strategy. Structural enhancement activities often involve dike breaching or removal to reconnect wetlands or sloughs.

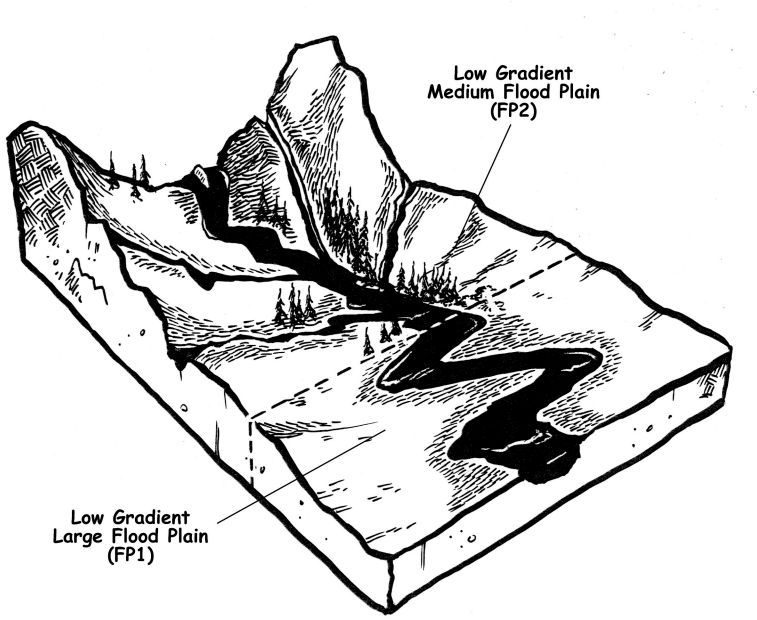
LOW GRADIENT LARGE FLOODPLAIN CHANNEL
FP1

FP1 channels are lowland and valley bottom channels of large watersheds. They may also occupy uplifted estuaries along the coast. Normally, these channels have extensive valley floodplains and river terraces. Sloughs, **oxbows**, wetlands, and abandoned channels are common in large river corridors. Smaller tributary streams may flow through channels abandoned by the main river. Numerous overflow **side-channels**, extensive gravel bars, avulsions, and log jams in forested basins are characteristic. They may be bordered on one bank by steep bluffs, marine terraces, or gentle slopes.

These channels function as sediment deposition systems, with short-term storage of fine sediment. Fines are typically mobilized during most high-flow events. Small side-channels dissecting the floodplain are common. In-channel wood accumulations are less stable than in smaller floodplain channels due to higher flood flows and greater channel width. Historically, many of these channels that drained forested areas contained significantly more wood than observed today.

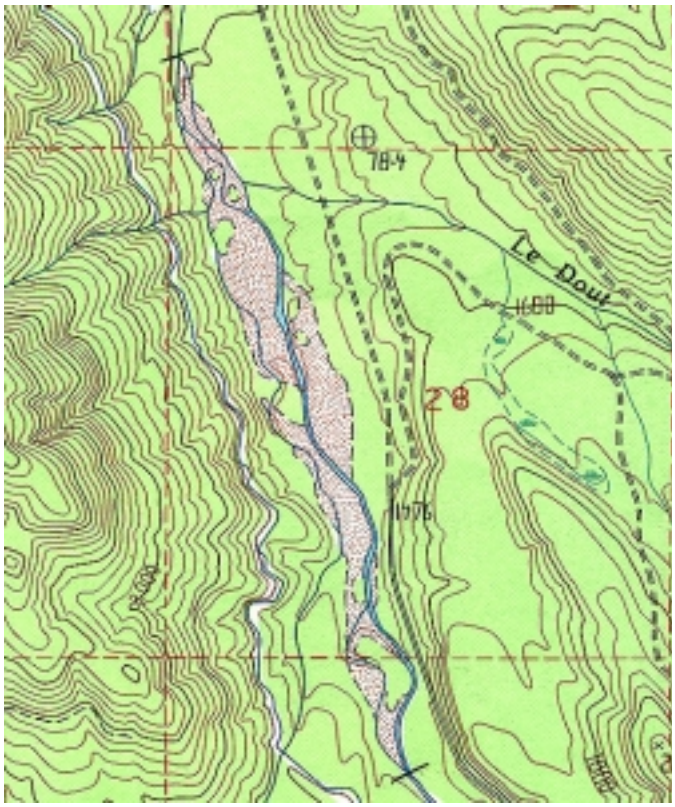
CHANNEL ATTRIBUTES

Stream gradient:	≤1%
Valley shape:	Broad valley, floodplain
Channel pattern:	Sinuous, single to multiple channels
Channel confinement:	Unconstrained
Oregon stream size:	Large
Position in drainage:	Bottom, low in drainage
Dominant substrate:	Sand to cobble



CHANNEL RESPONSIVENESS

Floodplain channels can be among the most responsive in the basin. The limited influence of confining terrain features and fine substrate allows the stream to move both laterally and vertically. Although often considered low-energy systems, these larger channels can mobilize large amounts of sediment during high flows. This often results in channel migration and new channel formation.



FP1 – Low Gradient Large Floodplain

Scale: Full (1:24,000)`
Contour Interval: 40 feet

Large Woody Debris: Moderate to High

Because of the great stream power, only large pieces or accumulations of pieces are likely to impact overall channel conditions. The role of wood and the amount and distribution of pieces is highly variable over time, as high flows regularly change conditions. Single pieces are likely to be associated with pools in side-channels and localized sediment depositions. Accumulations of wood are often responsible for the creation of midchannel bars and side-channel development.

Fine Sediment: Moderate

Fine sediment is easily mobilized by most of these channels. Increases in the supply of fines may cause temporary storage and pool filling, but moderate to high flows will mobilize the majority of the sediment. Deposition may be more permanent in smaller side-channels, and pool filling and minor shifts in side-channel location could occur.

Coarse Sediment: High

Floodplain channels are generally depositional areas for coarse sediment. When the supply of coarse sediment surpasses the transport capabilities of the stream, the channel is particularly vulnerable to widening, lateral movement, side-channel development, and **braiding**. Overall aquatic habitat complexity is reduced as pools are filled and obstructions such as large boulders or bedrock outcrops are buried.

Peak Flows: Low to Moderate

Large floodplain channels are usually capable of transporting high flows with a minimum of alteration to the primary physical characteristics of the channel. Flows tend to spread out across the valley rather than cause streambed scour. Localized bank erosion is expected as new channels are developed.

RIPARIAN ENHANCEMENT OPPORTUNITIES

Due to the unstable nature of these channels, the success of many enhancement efforts is questionable. Opportunities for enhancement do occur, however, especially in channels where lateral movement is slow. Lateral channel migration is common, and efforts to restrict this natural pattern will often result in undesirable alteration of channel conditions downstream. Smaller side-channels may be candidates for efforts that improve shade and bank stability, but it is likely that these efforts may be more beneficial and longer-lived elsewhere in the basin.

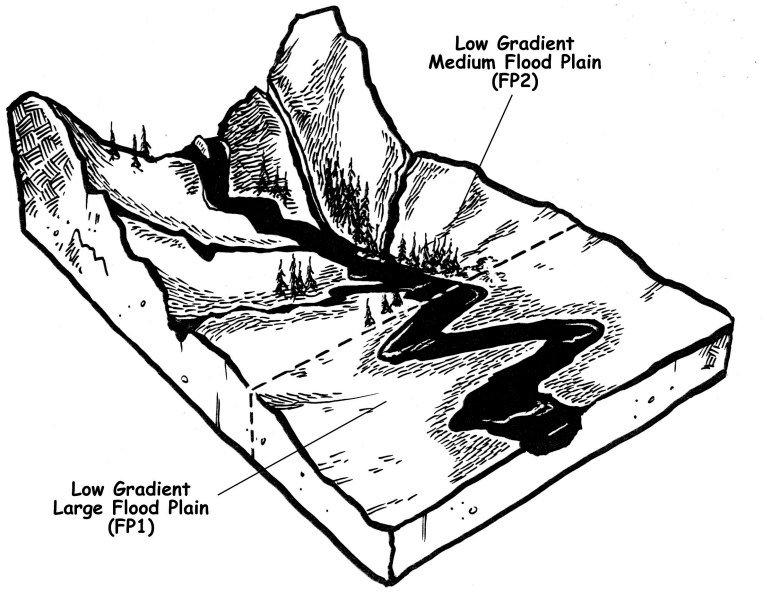
LOW GRADIENT MEDIUM FLOODPLAIN CHANNEL
FP2

FP2 channels are main-stem streams in broad valley bottoms with well-established floodplains. **Alluvial fans**, dissected **foot slopes**, and hill slope and lowland landforms may directly abut FP2 floodplains. Channels are often sinuous, with extensive gravel bars, multiple channels, and terraces. These channels are generally associated with extensive and complex riparian areas that may include such features as sloughs, side-channels, wetlands, beaver pond complexes, and small groundwater-fed tributary channels.

Sediment deposition is prevalent, with fine-sediment storage evident in pools and **point bars**, and on floodplains. Bank erosion and bank-building processes are continuous, resulting in a dynamic and diverse channel morphology. Stream banks are composed of fine alluvium and are susceptible to accelerated bank erosion with the removal or disturbance of stream-bank vegetation and root mats. Channel gradient is low, and high stream flows are not commonly contained within the active channel banks, resulting in relatively low stream power.

CHANNEL ATTRIBUTES

Stream gradient:	≤2%
Valley shape:	Broad, flat, or gentle landforms
Channel pattern:	Single to multiple channels, sinuous
Channel confinement:	Unconfined
Oregon stream size:	Large to medium
Position in drainage:	Middle to lower end of drainage basin
Dominant substrate:	Sand to cobble



CHANNEL RESPONSIVENESS

Floodplain channels can be among the most responsive in the basin. The limited influence of confining terrain features and fine substrate allows the stream to move both laterally and vertically. Although often considered low -energy systems, these channels can mobilize large mounts of sediment during high flows. This often results in channel migration and new channel formation.

Large Woody Debris: High

FP2 – Low Gradient Medium Floodplain

Scale: Full (1:24,000)
Contour Interval: 40 feet

Because of the high sedimentation rates, only large pieces or accumulations of smaller pieces are likely to impact overall channel conditions. The role of wood, as well as the amount and distribution of pieces, is variable over time, as high flows and stream power regularly change conditions. Single pieces are likely to be associated with pools in side-channels and localized sediment depositions. Accumulations of wood are often responsible for the creation of midchannel bars and side-channel development.

Fine Sediment: Moderate

Increases in the supply of fines may cause temporary storage and pool filling, but moderate to high flows will mobilize the majority of the sediment. Deposition may be more permanent in smaller side-channels, and pool filling and minor shifts in side-channel location could occur.

Coarse Sediment: High

Floodplain channels are generally depositional areas for coarse sediment. When the supply of coarse sediment surpasses the transport capabilities of the stream, the channel is particularly vulnerable to widening, lateral movement, side-channel development, and braiding. Overall aquatic habitat complexity is reduced, as pools are filled and obstructions such as large boulders or bedrock outcrops are buried.

Peak Flows: Low to Moderate

These floodplain channels are usually capable of transporting high flows with a minimum of alteration to the primary physical characteristics of the channel. Flows tend to spread out across the valley rather than cause streambed scour. Localized bank erosion is expected as new channels are developed, especially if the sediment supply has been increased.

RIPARIAN ENHANCEMENT OPPORTUNITIES

Due to the unstable nature of these channels, the success of many enhancement efforts is questionable. Opportunities for enhancement do occur, however, especially in channels where lateral movement is slow. Lateral channel migration is common, and efforts to restrict this natural pattern will often result in undesirable alteration of channel conditions downstream. Side-channels may be candidates for efforts that improve shade and bank stability.

LOW GRADIENT SMALL FLOODPLAIN CHANNEL
FP3

FP3 streams are located in valley bottoms and flat lowlands. They frequently lie adjacent to the toe of foot slopes or hill slopes within the valley bottom of larger channels, where they are typically fed by high-gradient streams. They may be directly downstream of a small alluvial fan and contain wetlands. FP3 channels may dissect the larger floodplain. These channels are often the most likely CHT to support beavers, if they are in the basin. Beavers can dramatically alter channel characteristics such as width, depth, form, and most aquatic habitat features.

These channels can be associated with a large floodplain complex and may be influenced by flooding of adjacent main-stem streams. Sediment routed from upstream high- and moderate-gradient channels is temporarily stored in these channels and on the adjacent floodplain.

CHANNEL ATTRIBUTES

Stream gradient:	≤2%
Valley shape:	Broad
Channel pattern:	Single to multiple channels
Channel confinement:	Moderate to unconfined
Oregon stream size:	Small to medium
Position in drainage:	Variable
Dominant substrate:	Sand to small cobble

CHANNEL RESPONSIVENESS

Floodplain channels can be among the most responsive in the basin. The limited influence of confining terrain features and fine substrate allows the stream to move both laterally and vertically. Although often considered low-energy systems, these channels can mobilize large amounts of sediment during high flows. This often results in channel migration and new channel formation.

Large Woody Debris: High

In forested basins, these channels are likely to have relatively high wood counts. Those located at the foot of high-gradient channels or along the margin of a large floodplain channel are especially subject to wood availability. Wood can readily affect channel pattern, location, and dimension. Wood is likely to be a major channel roughness element, often associated with pools or spawning gravel distribution.

Fine Sediment: Moderate to High

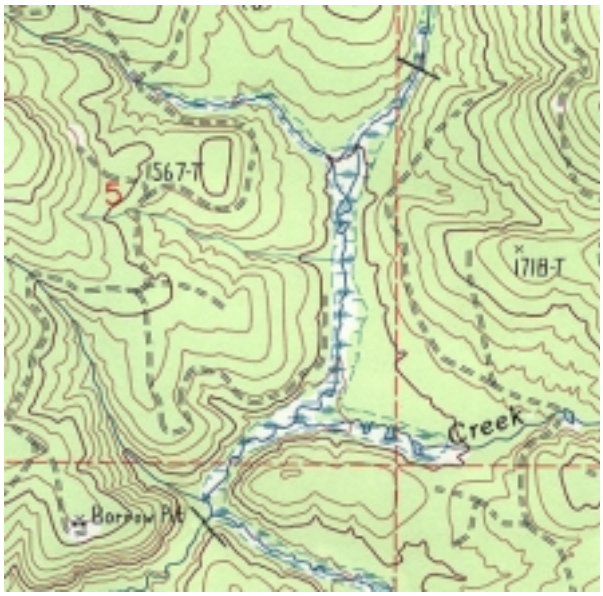
The location of these channels often dictates a high sediment input to the stream. These channels are sediment deposition zones, with side-channels particularly vulnerable to **aggradation** and shifting. If a large and persistent source of sediment is available, pool filling and channel migration could result.

Coarse Sediment: High

Floodplain channels are generally depositional areas for coarse sediment. When the supply of coarse sediment surpasses the transport capabilities of the stream, the channel is particularly vulnerable to widening, lateral movement, side-channel development, and braiding. Overall aquatic habitat complexity is reduced as pools are filled and obstructions such as large boulders or bedrock outcrops are buried.

Peak Flows: Low

Floodplain channels are usually capable of transporting high flows with a minimum of alteration to the primary physical characteristics of the channel. Flows tend to spread out across the valley rather than cause streambed scour. Localized bank erosion is expected as new channels are developed.



FP3 – Low Gradient Small Floodplain

Scale: Full (1:24,000)
Contour Interval: 40 feet

RIPARIAN ENHANCEMENT OPPORTUNITIES

Floodplain channels are, by their nature, prone to lateral migration, channel shifting, and braiding. While they are often the site of projects aimed at channel containment (diking, filling, etc.), it should be remembered that floodplain channels can exist in a dynamic equilibrium between stream energy and sediment supply. As such, the active nature of the channel should be respected, with restoration efforts carefully planned.

The limited power of these streams offers a better chance for success of channel enhancement activities than the larger floodplain channels. While the lateral movement of the channel will limit the success of many efforts, localized activities to provide bank stability or habitat development can be successful.

ALLUVIAL FAN CHANNEL
AF

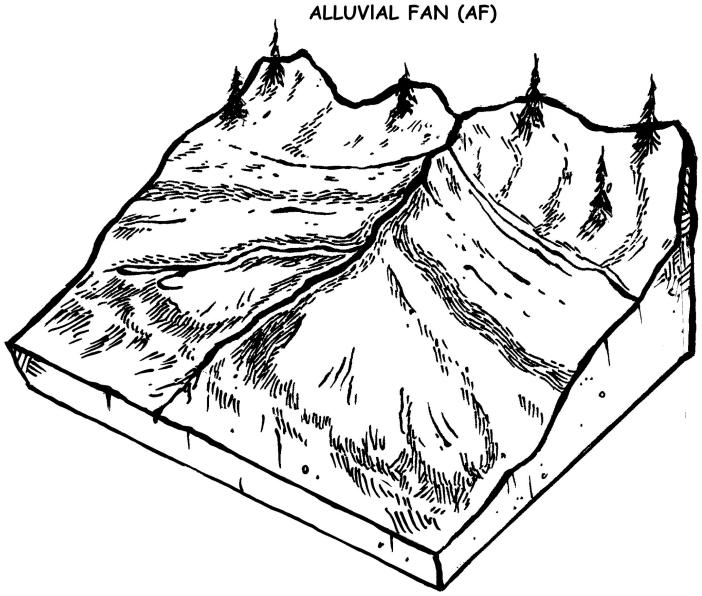
Alluvial fans are generally tributary streams that are located on foot-slope landforms in a transitional area between valley floodplains and steep mountain slopes. Alluvial fan deposits are formed by the rapid change in transport capacity as the high-energy mountain-slope stream segments spill onto the valley bottom. Channel pattern is highly variable, often dependent on substrate size and age of the landform. Channels may change course frequently, resulting in a multibranched stream network. Channels can also be deeply incised within highly erodible alluvial material. Smaller alluvial fan features may be difficult to distinguish from FP3 channels.

CHANNEL ATTRIBUTES

Stream gradient:	1-12%
Valley shape:	Where hill slopes open into broad valley
Channel pattern:	Single to multiple channels spread across the fan surface
Channel confinement:	Variable
Oregon stream size:	Small to medium
Position in drainage:	Lower end of small tributaries
Dominant substrate:	Fine gravel to large cobble

CHANNEL RESPONSIVENESS

The response of alluvial fans to changes in input factors is highly variable. Response is dependent on gradient, substrate size, and channel form. **Single-thread channels** confined by high banks are likely to be less responsive than an actively migrating multiple-channel fan. The moderate-gradient and alluvial substrate of many fans results in channels with a moderate to high overall sensitivity.



Large Woody Debris: Variable

In forested basins, these channels are likely to have relatively high wood counts. Those located at the foot of high-gradient channels are especially subject to wood availability. Wood can readily affect channel pattern, location, and dimension. Wood is likely to be a major channel roughness element, although the high sediment supply limits development of pools.

AF – Alluvial Fan

Scale: Full (1:24,000)
Contour Interval: 40 feet

Fine Sediment: Moderate to High

The location of these channels often dictates a high sediment input to the stream. These channels are sediment deposition zones for larger particles, although a significant portion of the fine sediment will be transported through higher-gradient fans. In lower-gradient fans, or those with heavy sediment input loads, the fine- and coarse-sediment deposition promotes channel migration and the development of multiple channels.

Coarse Sediment: High

Alluvial fans are depositional areas for coarse sediment. When the supply of coarse sediment surpasses the transport capabilities of the stream, the channel is vulnerable to widening, lateral movement, side-channel development, and braiding.

Peak Flows: Moderate to High

The capability of alluvial fans to pass large flows is highly variable. As the channel is bedded in alluvial material, high flows are capable of moving the channel bed, particularly in the higher-energy regions at the head of the fan. This often results in downcutting or creation of multiple channels.

RIPARIAN ENHANCEMENT OPPORTUNITIES

As many alluvial fans are actively moving at a rate greater than most channels, they are generally not well-suited to successful enhancement activities. Although they are considered responsive channels, long-term success of enhancement activities is questionable. High sediment loads often limit the success of efforts to improve habitat complexity such as wood placement for pool development.

LOW GRADIENT MODERATELY CONFINED CHANNEL
LM

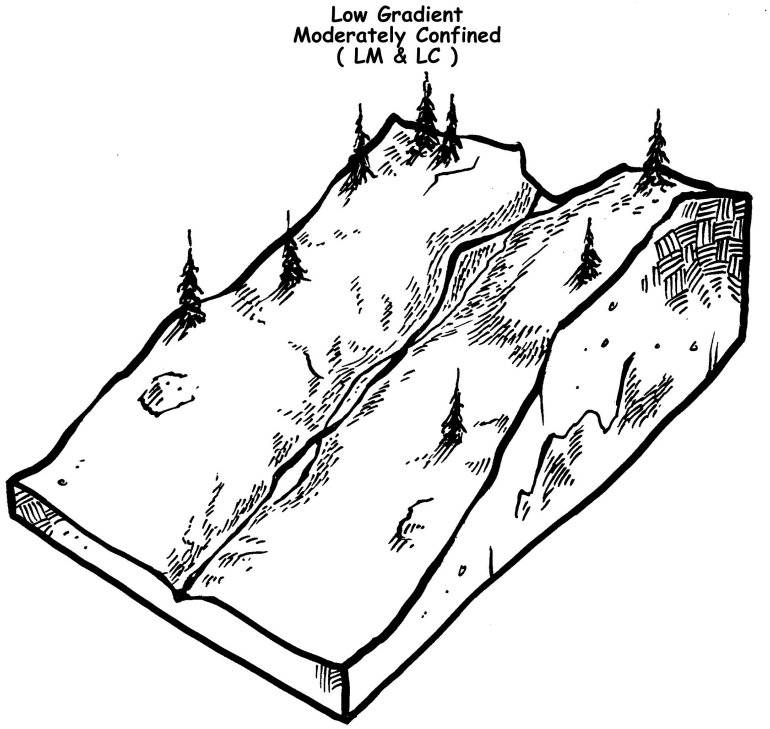
These channels consist of low-gradient reaches that display variable confinement by low terraces or hill slopes. A narrow floodplain approximately two to four times the width of the active channel is common, although it may not run continuously along the channel. Often low terraces accessible by flood flows occupy one or both sides of the channel. The channels tend to be of medium to large size, with substrate varying from bedrock to gravel and sand. They tend to be slightly to moderately sinuous, and will occasionally possess islands and side-channels. Because of the difficulty in assessing the degree of confinement and the height of stream-bank terraces from maps or air photos, these channels are often misidentified as LC channels unless field-checked.

CHANNEL ATTRIBUTES

Stream gradient:	<2%
Valley shape:	Broad, generally much wider than channel
Channel pattern:	Single with occasional multiple channels
Channel confinement:	Variable
Oregon stream size:	Variable, usually medium to large
Position in drainage:	Variable, often main-stem and lower end of main tributaries
Dominant substrate:	Fine gravel to bedrock

CHANNEL RESPONSIVENESS

The unique combination of an active floodplain and hill-slope or terrace controls acts to produce channels that can be among the most responsive in the basin. Multiple roughness elements are common, with bedrock, large boulders, or wood generating a variety of aquatic habitat within the stream network.



LM – Low Gradient Moderately Confined

Scale: Full (1:24,000)
Contour Interval: 40 feet

Large Woody Debris: Moderate to High

In forested basins, wood alone or in combination with other elements is associated with pool formation and maintenance, bar formation, and, occasionally, side-channel development. These channels may have relatively low wood numbers due to past management activities.

Fine Sediment: Moderate to High

The location of these channels often dictates a high sediment input to the stream. These channels can be sediment deposition zones for larger particles, although a significant portion of the fine sediment may be transported, particularly in bedrock channels. Increases in fine-sediment supply will likely result in filling of margin pool and bed-fining of side-channels and low-velocity areas. Decreases in sediment supply may induce scour in nonbedrock channels or localized bank erosion.

Coarse Sediment: Moderate to High

These channels are depositional areas for coarse sediment. When the supply of coarse sediment surpasses the transport capabilities of the stream, pools are filled, and the influence of large boulders, wood, and bedrock control structures is lessened. If significant amounts of large sediment are added, the channel is particularly vulnerable to widening, lateral movement, side-channel development, and localized scour.

Peak Flows: Moderate

These channels are capable of passing most high flows without adjustments to the overall dimensions of the channel. Development of point or **medial bars** is likely in basins with high sediment loads, as is side-channel development. Localized bed or bank scour is possible on bends in the main channel.

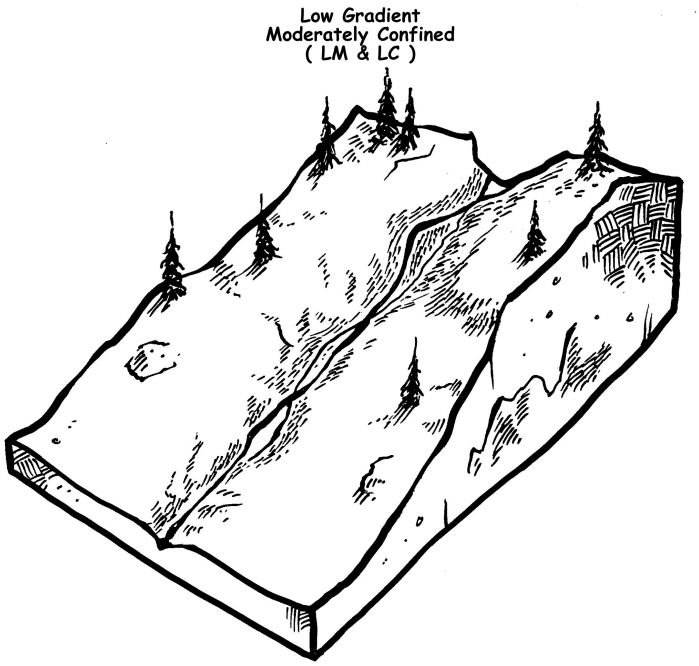
RIPARIAN ENHANCEMENT OPPORTUNITIES

Like floodplain channels, these channels can be among the most responsive of channel types. Unlike floodplain channels, however, the presence of confining landform features often improves the accuracy of predicting channel response to activities that may affect channel form. Additionally, these controls help limit the destruction of enhancement efforts common to floodplain channels. Because of this, LM channels are often good candidates for enhancement efforts.

In forested basins, habitat diversity can often be enhanced by the addition of roughness elements such as wood or boulders. Pool frequency and depth may increase, and side-channel development may result from these efforts. Channels of this type in nonforested basins are often responsive to bank stabilization efforts such as riparian planting and fencing. Beavers are often present in the smaller streams of this channel type, and fish habitat in some channels may benefit from beaver introduction through side-channel and scour pool development. Introduction of beavers, however, may have significant implications for overall channel form and function, and should be thoroughly evaluated by land managers as well as biologists as a possible enhancement activity.

LOW GRADIENT CONFINED CHANNEL
LC

LC channels are incised or contained within adjacent, gentle landforms or incised in volcanic flows or uplifted coastal landforms. Lateral channel migration is controlled by frequent bedrock outcrops, high terraces, or hill slopes along stream banks. They may be bound on one bank by hill slopes and lowlands on the other, and may have a narrow floodplain in places, particularly on the inside of meander bends. Stream-bank terraces are often present, but they are generally above the current floodplain. The channels are often stable, with those confined by hill slopes or bedrock less likely to display bank erosion or scour than those confined by alluvial terraces.



High-flow events are well-contained by the upper banks. High flows in these well-contained channels tend to move all but the most stable wood accumulations downstream or push debris to the channel margins. Stream banks can be susceptible to landslides in areas where steep hill slopes of weathered bedrock, glacial till, or volcanic-ash parent materials abut the channel.

CAUTION: Some degree of caution should be exercised in evaluating channels that have downcut into alluvial material set in a wide flat valley. If the stream banks are high enough to allow a floodplain width less than two times the bankfull width, then the stream meets the definition of confined. However, some streams meeting this definition may have recently downcut, effectively reducing floodplain width as the channel deepens. It is beyond the scope of this manual to deal with technical issues such as rate of channel incision. The analyst, however, should note channels that display evidence of recent downcutting, low channel banks, and evidence of abandoned floodplain. For whatever reason, these channels may be transitioning from LM to LC channels, and should receive additional scrutiny before assigning the proper CHT.

CHANNEL ATTRIBUTES

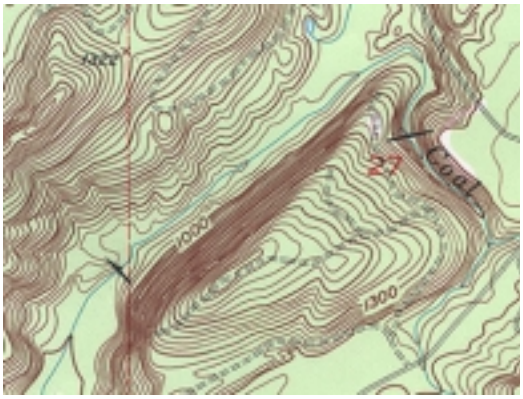
Stream gradient:	<2%
Valley shape:	Low- to moderate-gradient hill slopes with limited floodplain
Channel pattern:	Single channel, variable sinuosity
Channel confinement:	Confined by hill slopes or high terraces
Oregon stream size:	Variable, usually medium to large
Position in drainage:	Variable, generally mid to lower in the larger drainage basin
Dominant substrate:	Boulder, cobble, bedrock with pockets of sand/gravel/cobble

CHANNEL RESPONSIVENESS

The presence of confining terraces or hill slopes and control elements such as bedrock limit the type and magnitude of channel response to changes in input factors. Adjustment of channel features is usually localized and of a modest magnitude.

Large Woody Debris: Low to Moderate

In larger forested basins, wood numbers are often low in this channel type. This may be in part due to land management activities, but these channels usually display sufficient energy to route wood downstream. Also, limited lateral movement of the channel reduces the recruitment of wood from bank erosion. Wood is often present in jams or as large single pieces capable of withstanding high-energy flows. Even in streams of this channel type that are smaller and display less energy, wood may be routed or retained above the elevation of the bankfull channel, where it has limited impact on aquatic habitat.



LC – Low Gradient Confined

Scale: Full (1:24,000)
Contour Interval: 20 feet

Fine Sediment: Low

The confining nature of the landforms that define this channel type tends to focus enough stream energy to route most introduced fine sediment downstream. In basins with high background sediment levels, such as sand and siltstone-bedded channels in the Coast Range, supply may approach or surpass transport capacity, resulting in pool filling and **bed fining**.

Coarse Sediment: Moderate

These channels can be depositional areas for coarse sediment. When the supply of coarse sediment surpasses the transport capabilities of the stream, pools are filled, and the influence of large boulders, wood, and bedrock control structures is lessened. If significant amounts of large sediment are added, the channel is particularly vulnerable to widening, lateral movement, side-channel development, or scour.

Peak Flows: Low to Moderate

These channels have limited floodplain, and are capable of passing most high flows without adjustments to the overall dimensions of the channel. Development of point or medial bars is likely in basins with high sediment loads. Localized bed or bank scour is possible on bends in the main channel.

RIPARIAN ENHANCEMENT OPPORTUNITIES

These channels are not highly responsive, and in channel enhancements may not yield intended results. In basins where water-temperature problems exist, the confined nature of these channels lends itself to establishment of riparian vegetation. In nonforested land, these channels may be deeply incised and prone to bank erosion from livestock. As such, these channels may benefit from livestock access control measures.

MODERATE GRADIENT MODERATELY CONFINED CHANNEL MM

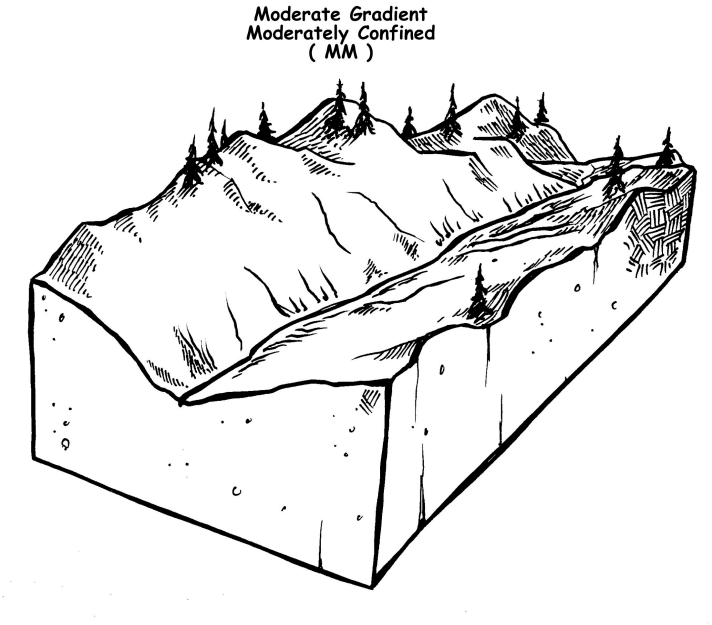
This group includes channels with variable controls on channel confinement. Alternating valley terraces and/or adjacent mountain-slope, foot-slope, and hill-slope landforms limit channel migration and floodplain development. Similar to the LM channels, a narrow floodplain is usually present, and may alternate from bank to bank. Bedrock steps with cascades may be present.

CHANNEL ATTRIBUTES

Stream gradient:	Generally 2-4%
Valley shape:	Narrow valley with floodplain or narrow terrace development
Channel pattern:	Usually single channel, low to moderate sinuosity
Channel confinement:	Variable
Oregon stream size:	Variable, usually medium to large
Position in drainage:	Mid to lower portion of drainage basins
Dominant substrate:	Gravel to small boulder

CHANNEL RESPONSIVENESS

The unique combination of a narrow floodplain and hill-slope or terrace controls acts to produce channels that are often the most responsive in the basin. The combination of higher gradients and the presence of a floodplain set the stage for a dynamic channel system. Multiple roughness elements such as bedrock, large boulders, or wood may be common, resulting in a variety of aquatic habitats within the stream network.



Large Woody Debris: High

In forested basins, wood alone or in combination with other elements is associated with pool formation and maintenance, bar formation and gravel sorting, and, occasionally, side-channel development. LWD may be the primary factor responsible for forming pools in forested systems. Due to the moderate gradient, smaller pieces are transported downstream or form jams. A change in the wood supply would likely have significant impact on pool condition, sediment movement, bar development, and, possibly, side-channel condition.

Fine Sediment: Moderate

The location of these channels often dictates a high sediment input to the stream. These channels can be sediment deposition zones for larger particles, although the moderate gradient produces enough energy to route most of the fine sediment downstream. Increases in fine-sediment supply will likely result in filling of margin pool and bed fining of side-channels and low-velocity areas. Decreases in sediment supply may induce scour in nonbedrock channels or localized bank erosion

MM – Moderate Gradient Moderately Confined

Scale: Full (1:24,000)
Contour Interval: 40 feet

Coarse Sediment: Moderate to High

Unless the channel is quite large, these channels may be temporary storage areas for coarse sediment. When the supply of coarse sediment surpasses the transport capabilities of the stream, pools are filled, and the influence of large boulders, wood, and bedrock control structures is lessened. If significant amounts of large sediment are added, the channel is particularly vulnerable to widening, lateral movement, side-channel development, or scour. Steeper channels within this CHT would likely transport a greater portion of the load and not be as responsive as lower-gradient reaches.

Peak Flows: Moderate

These channels have limited floodplain, and are capable of passing most high flows without adjustments to the overall dimensions of the channel. The higher energy induced by steeper gradients can result in development of point or medial bars in basins with high sediment loads, as well as side-channel development. Localized bed or bank scour is possible on bends in the main channel.

RIPARIAN ENHANCEMENT OPPORTUNITIES

Like floodplain channels, these channels are among the most responsive of channel types. Unlike floodplain channels, however, the presence of confining landform features improves the accuracy of predicting channel response to activities that may affect channel form. Additionally, these controls help limit the destruction of enhancement efforts, a common problem in floodplain channels. The slightly higher gradients impart a bit more uncertainty as to the outcome of enhancement efforts when compared to LM channels. MM channels, however, are often good candidates for enhancement efforts.

In forested basins, habitat diversity can often be enhanced by the addition of roughness elements such as wood or boulders. Pool frequency and depth may increase as well as side-channel development as the result of these efforts. Channels of this type in nonforested basins are often responsive to bank stabilization efforts such as riparian planting and fencing.

Beavers are often present in the smaller streams of this channel type, and fish habitat in some channels may benefit from beaver introduction through side-channel and scour pool development. Introduction of beavers, however, may have significant implications for overall channel form and function, and should be thoroughly evaluated by land managers as well as biologists as a possible enhancement activity.

MODERATE GRADIENT CONFINED CHANNEL
MC

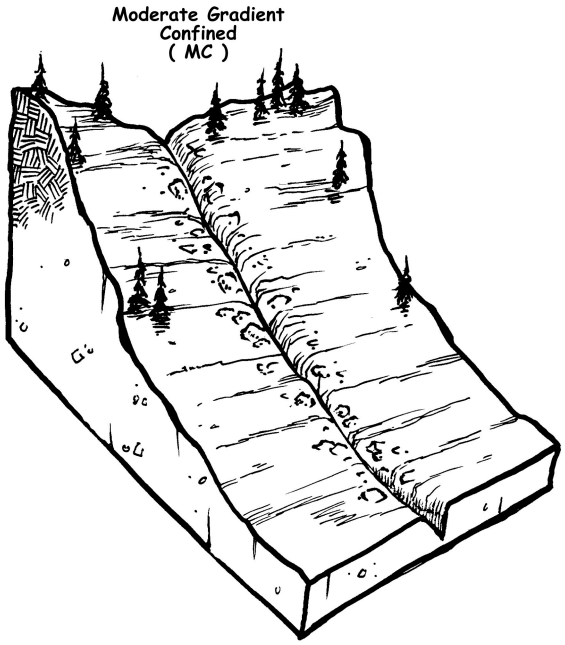
MC streams flow through narrow valleys with little river terrace development, or are deeply incised into valley floors. Hill slopes and mountain slopes composing the valley walls may lie directly adjacent to the channel. Bedrock steps, short falls, cascades, and boulder runs may be present; these are usually sediment transport systems. Moderate gradients, well-contained flows, and large-particle substrate indicate high stream energy. Landslides along channel side slopes may be a major sediment contributor in unstable basins.

CHANNEL ATTRIBUTES

Stream gradient:	2-4%, may vary between 2 to 6%
Valley shape:	Gentle to narrow V-shaped valley, little to no floodplain development
Channel pattern:	Single, relatively straight or conforms to hill-slope control
Channel confinement:	Confined
Oregon stream size:	Variable
Position in drainage:	Middle to lower
Dominant substrate:	Coarse gravel to bedrock

CHANNEL RESPONSIVENESS

The presence of confining terraces or hill slopes and control elements such as bedrock substrates limits the type and magnitude of channel response to changes in input factors. Adjustment of channel features is usually localized and of a modest magnitude.



Large Woody Debris: Low

In larger forested basins, wood numbers are often low in this channel type. This may be, in part, due to past land management activities, but these channels usually display sufficient energy to route wood downstream. Also, limited lateral movement of the channel reduces the recruitment of wood from bank erosion. Wood is often present in jams or as large single pieces capable of withstanding high-energy flows. Even in streams of this channel type that are smaller and display less energy, wood may be routed or retained above the elevation of the bankfull channel, where it has limited impact on aquatic habitat.

Fine Sediment: Low

The confining nature of the landforms and the moderate gradient combine to produce enough stream energy to route most introduced fine sediment downstream. Localized pool filling and bed fining may occur if a large and persistent source exists.

Coarse Sediment: Moderate

These channels can be both a transport or deposition area for coarse sediment. When the supply of coarse sediment surpasses the transport capabilities of the stream, pools are filled, and the influence of large boulders, wood, and bedrock control structures is lessened. If significant amounts of large sediment are added, the channel is particularly vulnerable to widening, limited lateral movement, or scour.

Peak Flows: Moderate

These channels have limited floodplain, and are capable of passing most high flows without adjustments to the overall dimensions of the channel. Development of point or medial bars is likely in basins with high sediment loads. Localized bed or bank scour is possible on bends in the main channel.

MC – Moderate Gradient Confined

Scale: Full (1:24,000)
Contour Interval: 40 feet

RIPARIAN ENHANCEMENT OPPORTUNITIES

These channels are not highly responsive, and in-channel enhancements may not yield intended results. Although channels are subject to relatively high energy, they are often stable. In basins where water-temperature problems exist, the stable banks generally found in these channels lend themselves to establishment of riparian vegetation. In nonforested land, these channels may be deeply incised and prone to bank erosion from livestock. As such, these channels may benefit from livestock access control measures.

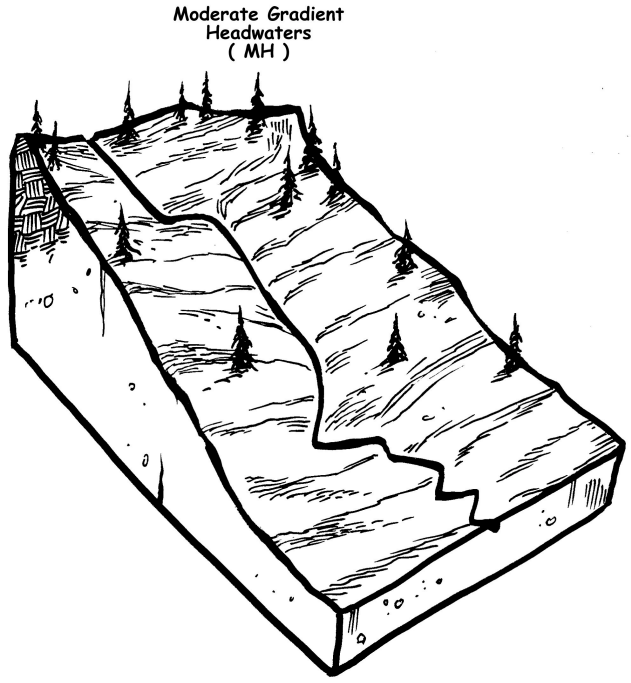
MODERATE GRADIENT HEADWATER CHANNEL
MH

These moderate-gradient headwater channels are common to plateaus in Columbia River basalts, young volcanic surfaces, or broad drainage divides. They may be sites of headwater beaver ponds. These channels are similar to LC channels, but occur exclusively in headwater regions. They are potentially above the **anadromous fish** zone.

These gentle to moderate headwater streams generally have low streamflow volumes and, therefore, low stream power. The confined channels provide limited sediment storage in low-gradient reaches. Channels have a small upslope drainage area and limited sediment supply. Sediment sources are limited to upland surface erosion.

CHANNEL ATTRIBUTES

Stream gradient:	1-6%
Valley shape:	Open, gentle V-shape valley
Channel pattern:	Low sinuosity to straight
Channel confinement:	Confined
Oregon stream size:	Small
Position in drainage:	Upper, headwater
Dominant substrate:	Sand to cobble, bedrock; boulders may be present from erosion of surrounding slopes and soils



CHANNEL RESPONSIVENESS

The low stream power and presence of confining terraces or hill slopes and control elements such as bedrock substrates limit the type and magnitude of channel response to changes in input factors. Adjustment of channel features is usually localized and of a moderate magnitude.

Large Woody Debris: Moderate

Wood numbers and influence is quite variable in these channels. While the low stream energy may limit the magnitude of response associated with wood, wood numbers can be high and wood may be the dominant roughness element. In these cases, wood is critical for pool and cover habitat formation and maintenance.

Fine Sediment: Moderate

The confining nature of the landforms that define this channel type tends to focus enough stream energy to route much of the introduced fine sediment downstream. Localized pool filling and bed fining can occur in lower-gradient reaches.

Coarse Sediment: Moderate to High

The low energy in these small channels is incapable of transporting larger sediment. Increases in the sediment load can easily overwhelm the channel and result in widening, lateral movement, or scour. In some basins, the location of these channels makes them vulnerable to inputs of sediment and wood from slides.

MH – Moderate Gradient Headwater

Scale: Full (1:24,000)
Contour Interval: 40 feet

Peak Flows: Moderate

These channels have limited floodplain, and are capable of passing most high flows without adjustments to the overall dimensions of the channel. Localized bed or bank scour is possible on bends in the main channel.

RIPARIAN ENHANCEMENT OPPORTUNITIES

These channels are moderately responsive. In basins where water-temperature problems exist, the stable banks generally found in these channels lend themselves to establishment of riparian vegetation. In nonforested land, these channels may be deeply incised and prone to bank erosion from livestock. As such, these channels may benefit from livestock access control measures.

MODERATELY STEEP NARROW VALLEY CHANNEL
MV

MV channels are moderately steep and confined by adjacent moderate to steep hill slopes. High flows are generally contained within the channel banks. A narrow floodplain, one channel width or narrower, may develop locally.

MV channels efficiently transport both coarse bedload and fine sediment. Bedrock steps, boulder cascades, and chutes may be common features. The large amount of bedrock and boulders create stable streambanks; however, steep side slopes may be unstable. Large woody debris is found commonly in jams that trap sediment in locally low-gradient steps.

CHANNEL ATTRIBUTES

Stream gradient:	4-8%, may vary between 3 to 10%
Valley shape:	Narrow, V-shaped valley
Channel pattern:	Single channel, relatively straight similar to valley
Channel confinement:	Confined
Oregon stream size:	Small to medium
Position in drainage:	Mid to upper
Dominant substrate:	Small cobble to bedrock

CHANNEL RESPONSIVENESS

The gradient and presence of confining terraces or hill slopes and control elements such as bedrock substrates limit the type and magnitude of channel response to changes in input factors. Adjustment of channel features is localized and of a minor magnitude.

Large Woody Debris: Moderate

In larger forested basins, wood numbers are often high in this channel type. Wood is present in jams or as single pieces capable of withstanding high-energy flows. Large woody debris may be the primary element responsible for pool formation and development. In bedrock systems, wood has less influence, and is often transported downstream.

Fine Sediment: Low

The confining nature of the landforms and the higher gradients combine to produce enough stream energy to route most introduced fine sediment downstream. Filling of lateral pools and lower-energy areas may result from increases in the sediment supply.

Coarse Sediment: Moderate

These channels are usually transport reaches for coarse sediment, although lower-energy sections can retain sediment and adjust channel dimensions. When the supply of coarse sediment surpasses the transport capabilities of the stream, pools are filled, and the influence of large boulders, wood, and bedrock control structures is lessened.

MV – Moderately Steep Narrow Valley

Scale: Full (1:24,000)
Contour Interval: 40 feet

Peak Flows: Moderate

These channels have limited floodplain, and are capable of passing most high flows without adjustments to the overall dimensions of the channel. Development of point or medial bars is likely in basins with high sediment loads. Localized bed or bank scour is possible on bends in the main channel.

RIPARIAN ENHANCEMENT OPPORTUNITIES

These channels are not highly responsive, and in channel enhancements may not yield intended results. Although channels are subject to relatively high energy, they are often stable. In basins where water-temperature problems exist, the stable banks generally found in these channels lend themselves to establishment of riparian vegetation. In nonforested land, these channels may be deeply incised and prone to bank erosion from livestock. As such, these channels may benefit from livestock access control measures.

BEDROCK CANYON CHANNEL
BC

BC channels are associated with valley bottom gorge landforms typically cut through bedrock with long, steep, side-slope walls. Channel features include cascades, rapids, and major falls, although long pools may exist.

CHANNEL ATTRIBUTES

Stream gradient:	>4%, can be locally lower
Valley shape:	Canyons, gorges, very steep mountain side slopes
Channel pattern:	Single channel, straight
Channel confinement:	Tightly confined by bedrock slopes
Oregon stream size:	Variable
Position in drainage:	Variable
Dominant substrate:	Bedrock, large boulders

CHANNEL RESPONSIVENESS

The bedrock side slopes and channel bed severely limit the sensitivity of these channels to change. They are the least responsive of the identified channel types.

Large Woody Debris: Low

Wood is generally transported out of these reaches, although jams can develop in lower-gradient canyons. Bedrock is the defining roughness element, with wood playing a minor role.

Fine Sediment: Low

The confining nature of the landform produces enough stream energy to route most introduced fine sediment downstream. Temporary storage of fines in low-gradient pools may occur.

Coarse Sediment: Low

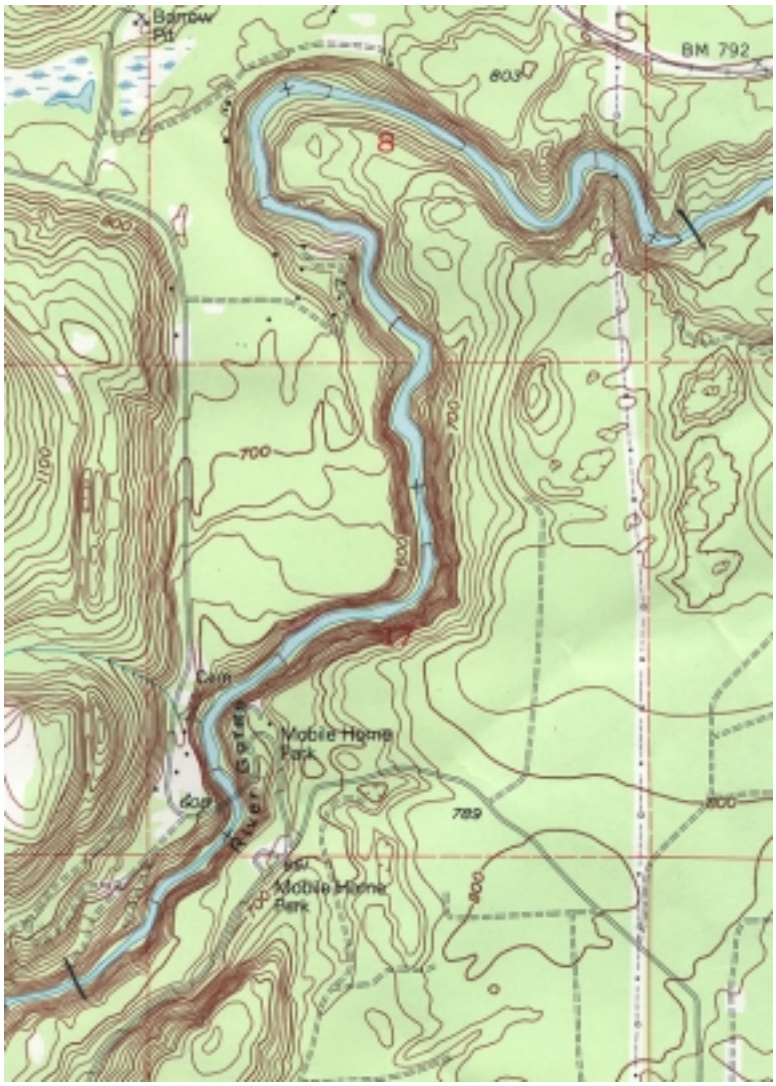
These channels are usually transport reaches for coarse sediment, although lower-energy sections can retain sediment for a limited time.

Peak Flows: Low

These channels have no floodplain, and are capable of passing high flows without adjustments to the overall dimensions of the channel.

RIPARIAN ENHANCEMENT OPPORTUNITIES

These channels are not responsive, and are generally a poor site for enhancement efforts.



BC – Bedrock Canyon

Scale: Full (1:24,000)
Contour Interval: 20 feet

STEEP NARROW VALLEY CHANNEL
SV

VERY STEEP HEADWATER
VH

These two channel types are very similar, except that VH channels are steeper. Because of this similarity, they are presented together. SV channels are situated in a constricted valley bottom bounded by steep mountain or hill slopes. Vertical steps of boulder and wood with scour pools, cascades, and falls are common. VH channels are found in the headwaters of most drainages or side slopes to larger streams, and commonly extend to ridge-tops and summits. These steep channels may be shallowly or deeply incised into the steep mountain or hill slope. Channel gradient may be variable due to falls and cascades.

CHANNEL ATTRIBUTES

Stream gradient:	SV 8-16%, VH >16%
Valley shape:	Steep, narrow V-shaped valley
Channel pattern:	Single, straight
Channel confinement:	Tightly confined
Oregon stream size:	Small, small-medium transition
Position in drainage:	Middle upper to upper
Dominant substrate:	Large cobble to bedrock

CHANNEL RESPONSIVENESS

The gradient and presence of confining terraces or hill slopes and control elements such as bedrock substrates limit the type and magnitude of channel response to changes in input factors. Adjustment of channel features is localized and of a minor magnitude. These channels are also considered source channels supplying sediment and wood to downstream reaches, sometimes via landslides.

Large Woody Debris: Moderate

In larger forested basins, wood numbers are often high in these channel types. Large woody debris may be the primary element responsible for pool formation and development. In bedrock systems, wood has less influence, and is often transported downstream.

Fine Sediment: Low

The confining nature of the landforms and the higher gradients combine to produce enough stream energy to route most introduced fine sediment downstream. Filling of lateral pools and lower-energy areas may result from increases in the sediment supply.

Coarse Sediment: Low to Moderate

These channels are usually transport reaches for coarse sediment, although lower-energy sections can retain sediment and adjust channel dimensions. When the supply of coarse sediment surpasses the transport capabilities of the stream, pools are filled, and the influence of large boulders, wood, and bedrock control structures is lessened. Minor channel widening or scour can occur.

Peak Flows: Low

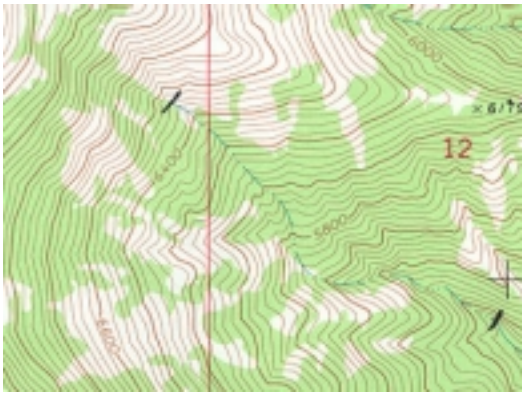
These channels have limited floodplain, and are capable of passing most high flows without adjustments to the overall dimensions of the channel. Localized bed or bank scour is possible.

SV – Steep Narrow Valley

Scale: Full (1:24,000)
Contour Interval: 40 feet

RIPARIAN ENHANCEMENT OPPORTUNITIES

These channels are not highly responsive, and in channel enhancements may not yield intended results. Although channels are subject to relatively high energy, they are often stable. In basins where water-temperature problems exist, the stable banks generally found in these channels lend themselves to establishment of riparian vegetation. This may also serve as a recruitment effort for LWD in the basin.



VH – Very Steep Headwater

Scale: Full (1:24,000)
Contour Interval: 40 feet

REFERENCES

Cupp, C.E. 1989. Stream Corridor Classification for Forested Lands of Washington. State of Washington, Timber/Fish/Wildlife Ambient Monitoring Program, Olympia.

Frissell, C.A., W.J. Liss, C.E. Warren, and M.D.Hurley. 1986. A Hierarchical Framework for Stream Habitat Classification: Viewing Streams in a Watershed Context. Environmental Management 10(2):199-214.

Montgomery, D.R., and J.M. Buffington. 1993. Channel Classification, Prediction of Channel Response, and Assessment of Channel Condition. Washington State Timber/Fish/Wildlife Report TFW-SH10-93-002, Olympia.

Moore, K., K. Jones, and J. Dambacher. 1997. Methods for Stream Habitat Surveys. Aquatic Inventory Project, Natural Production Program: Oregon Department of Fish and Wildlife.

Oregon Department of Land Conservation and Development. 1987. Estuary Plan Book.

Paustian, S.J. (editor), et al. 1992. Channel Type Users Guide for the Tongass National Forest, Southeast Alaska. US Department of Agriculture Forest Service, Alaska Region, R10 Technical Paper 26.

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.

GLOSSARY

aggradation: Raising of the channel bed elevation due to sediment deposition.

alluvial fan: An area where large amounts of sediment are deposited by a stream as the stream gradient rapidly decreases.

anadromous fish: Fish that move from the sea to fresh water for reproduction.

bed fining: An increase in the amount of fine sediment (<2 mm) in the stream channel bed.

braiding: Branching of a stream into many channels.

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.

delta: At a river's mouth, the sediment deposits found between the diverging channels.

estuary: Area of a river mouth where the fresh water of a river mixes with ocean water.

foot slope: Area located at the bottom of a hill slope.

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

intertidal: The shore region between high and low tide.

large woody debris (LWD): Logs, stumps, or root wads in the stream channel, or nearby. These function to create pools and cover for fish, and to trap and sort stream gravels.

medial bar: Sediment deposit in a river that protrudes above the water surface and is not connected to shore.

morphologic response: In stream channels, the response or change in the characteristics that define the channel.

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.

mudflat: Intertidal zone whose substrate consists primarily of silt and clay and is usually unvegetated.

oxbow: A bow-shaped river bend.

point bar: A sediment deposit in a river that protrudes above the water surface and is located primarily on the inside of bends in the channel.

relic channel: A channel historically occupied by a river, but that currently does not convey flow.

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

scour: Removal of sediment from the bed or banks of a river by the energy of moving water.

side-channel: A channel that is separated from the main channel, usually by an island.

single-thread channel: A stream channel that has no side channels, braiding, or islands.

slough: A side channel within an estuary.

stream reach: A section of stream possessing similar physical features such as gradient and confinement.