CALIFORNIA SALMONID STREAM HABITAT RESTORATION MANUAL

PART III

HABITAT INVENTORY METHODS

PART III HABITAT INVENTORY METHODS

Following completion of a preliminary watershed overview, a stream habitat inventory should be conducted. The preferred procedures used to accomplish fish habitat inventory include: 1) stream channel typing using the stream classification system developed by D. L. Rosgen (1994); and 2) habitat typing using a variation of the system originally developed by P. A. Bisson, et al. (1982) and later expanded by others. Stream channel typing describes relatively long reaches within a stream using eight morphological characteristics. Habitat typing describes the specific pool, flatwater, and riffle habitats within a stream.

The different habitat types and their boundaries are easily identified once the surveyor gains experience. Changes in stream channel types are more subtle and require a surveyor to recognize changes in substrate, channel entrenchment, gradient, and other morphological characteristics that signal a different channel type.

The field data collected is used for stream analysis and planning. DFG has developed a data entry and summary program to process the field data (Part V). An examination of the results will provide the baseline data necessary to determine if habitat modification may be appropriate. If habitat projects are implemented, baseline data are vital for evaluation and monitoring.

Before deciding whether or not to modify fish habitat in a stream reach, judgements can be made as to the need and range of suitable structures applicable to the stream channel type. Rosgen and Fittante (1986), and Rosgen (1994) developed guidelines for evaluating the suitability of a wide variety of commonly used habitat enhancement designs over a wide range of channel types. (Pages III-8 through III-21, Stream Channel Type Descriptions and Structure Suitability).

HABITAT INVENTORY FIELD PREPARATION

All habitat inventory field work must be conducted by two persons. Wading shoes with non-slip soles are recommended. If hip boots, chest waders, or hiking boots are used, non-slip soles or non-slip cleats must be worn.

Permission to trespass must be obtained before field work begins on private land (Appendix N). The designated agency manager of public land should always be notified before inventory work begins on public land.

Most surveyors use a day pack or a vest to carry their tools and supplies, a coat or rain gear, food, and water. Do not drink any stream water that has not been purified and treated to destroy *Giardia*.

Tools and Supplies Needed for Two Person Crew

- Stream Channel Typing Work Sheet and Habitat Inventory Data Forms
- Pencil(s) and waterproof marker(s)
- Plastic flagging
- Topographic maps (it is best to carry photocopies)
- Camera (film)
- Thermometer
- Watch
- Stadia rod (fiberglass, calibrated in tenths)
- Fiberglass open reel tape 200 ft.
- Optical range finder (optional)
- Hand level
- Flow meter
- Compass
- Hip chain and thread
- Spherical densiometer
- Aluminum clipboard and waterproof notebook
- First aid kit
- Aluminum nails and tags (for marking reference points)
- Cruiser's vest or day pack
- Footwear with non-slip soles

STREAM CLASSIFICATION SYSTEM

This manual uses a modified stream classification system developed by Rosgen (1994). Stream types are characterized by eight morphological features:

1) Channel width
2) Depth
3) Velocity
4) Discharge
5) Channel slope
6) Roughness of channel materials
7) Sediment load
8) Sediment size

Some applications of stream classification data include:

- Determine the suitability of habitat restoration structures.

- Describe specific stream reaches by channel type and sequence within the basin.

- Predict a stream's behavior from its appearance.

- Describe the condition of the stream and its ability to transport the sediment yield from the watershed.

- Provide a consistent and reproducible frame of reference for communication among those working with river systems.

Stream Channel Type Definitions

The following terminology is provided to gain an understanding of the measurable information needed to classify stream types.

Channel type unit length: A stream reach must exhibit the same channel type over a minimum distance of twenty bankfull channel widths to be recognized as an independent stream channel type unit.

Bankfull discharge (Q_{bkf}): The dominant channel forming flow, and has a recurrence interval of 1.5 years.

Bankfull depth (d_{bkf}): The mean depth measured at bankfull discharge.

Bankfull width (W_{bkf}): The channel width at bankfull discharge. This stage is delineated by the presence of a floodplain at the elevation of incipient flooding and indicated by deposits of fine sediments such as sand or silt at the active scour mark, break in stream bank slope, and/or perennial vegetation limit (Figure III-1).

Flood-prone area: Any flat, or nearly flat lowland that borders a stream and is covered by its waters at flood stage (Figure III-1). This is determined at twice the maximum bankfull depth.

Flood-prone width (W_{FP}): The stream width at a discharge level defined as twice the maximum bankfull depth.

Wetted width: The width of the wetted stream at the time of the survey. Wetted width is generally less than bankfull width. Wetted width is also referred to as Alow flow channel”.

Stream Type Delineation Criteria

The Rosgen delineation criteria includes general description, width/depth ratio, water surface slope/gradient, dominant particle size, entrenchment and sinuosity.

General description: A general description of the channel geometry, gradient, bank stability, substrate, pool or riffle occurrence, etc.

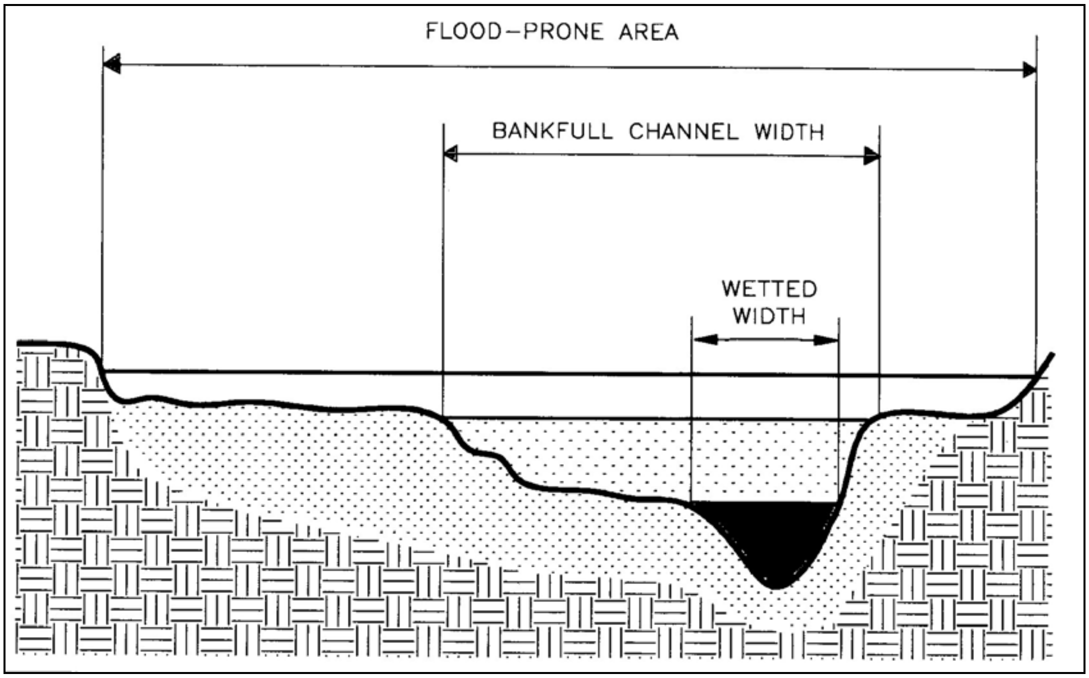


Figure III-1. Channel cross section.

Width/depth ratio: The ratio of the bankfull width (W_{bkf}) to the bankfull mean depth (d_{bkf}). The categories are:

1) Low ($W_{bkf}/d_{bkf} < 12$)
2) Moderate to High (W_{bkf}/d_{bkf} 12 - 40)
3) Very High ($W_{bkf}/d_{bkf} > 40$)

Water surface slope/gradient: The slope of the water surface is measured over a distance of at least 20 bankfull channel widths at velocity crossovers.

Dominant substrate: The most common particle found on the bed of the stream measured at the velocity crossover. The particles are classified by their maximum diameter.

PARTICLE SIZE:	INCHES
Boulder	> 10"
Cobble	2.5-10"
Gravel	0.08-2.5"
Sand	< 0.08"
Silt/clay	N/A
Bedrock	N/A

Entrenchment: The ratio between flood-prone width (W_{FP}) and bankfull width (W_{bkf}). There are three categories (Figure III-2):

1) Entrenched (W_{FP} /W_{bkf} <1.4)
2) Moderately entrenched (W_{FP} /W_{bkf} 1.4 to 2.2)
3) Slightly entrenched (W_{FP} /W_{bkf} >2.2)

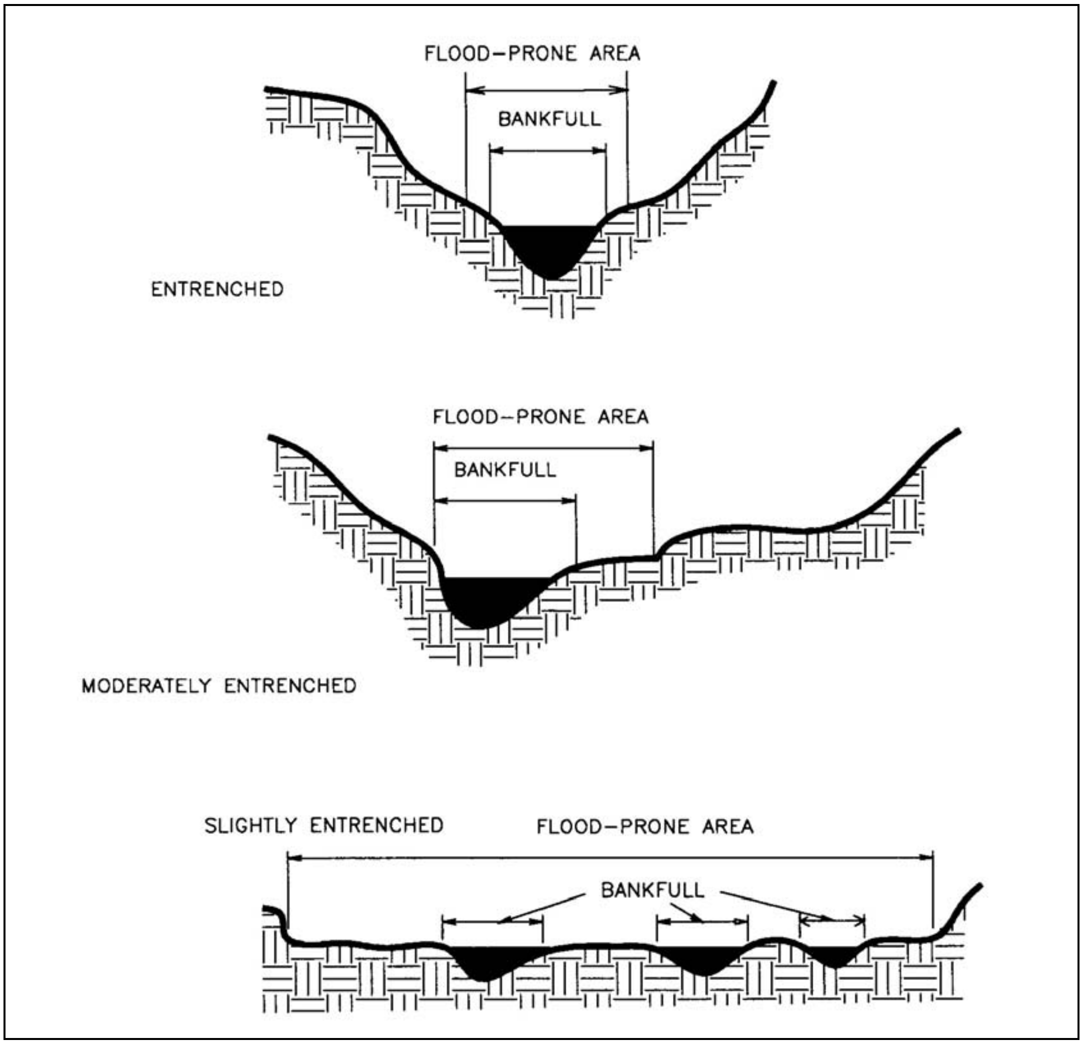


Figure III-2. Entrenchment.

Sinuosity: The ratio between stream length and valley length (Figure III-3).

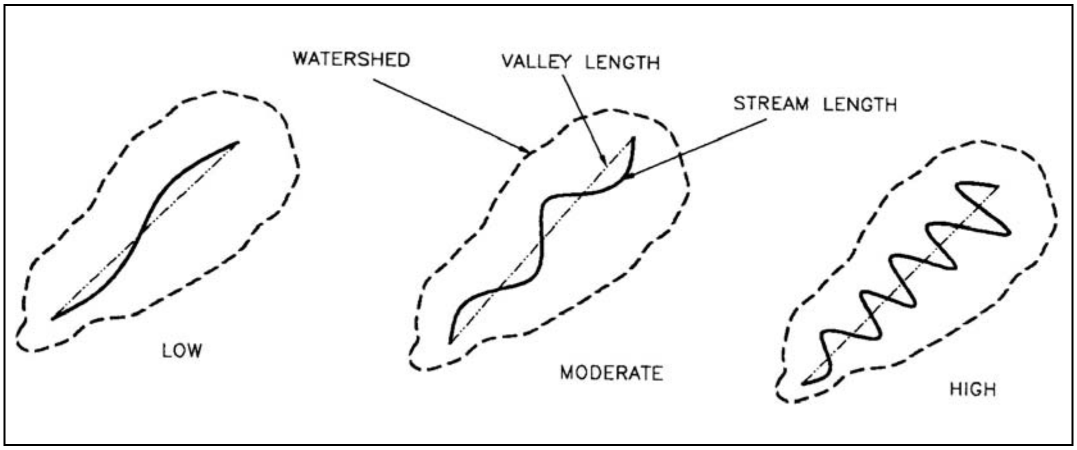


Figure III-3. Sinuosity.

The following picture depicts a generalized spatial relationship of different stream types as described by Rosgen (1994). Typically "A" type stream channels are located in the highly confined steep gradient reaches (4 percent or greater). As you move downstream and confinement and gradient decrease, stream channels typically grade to "B" and then "C" stream channel categories until reaching areas of no confinement, typically "D" type stream channels (Figure III-4). However, stream order and physiographic position within the drainage do not necessarily indicate stream type. For example, a "D" stream type may occur in the headwaters of a particular stream as an alluvial fan downstream of a glacial outfall.

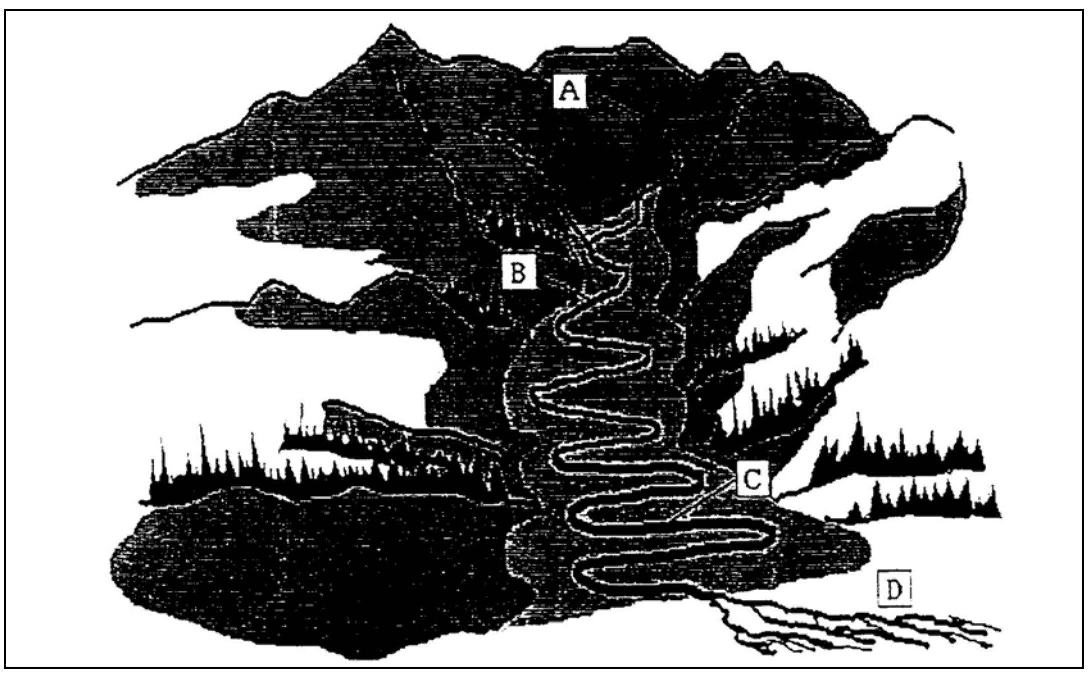


Figure III-4. Relationship of different stream types.

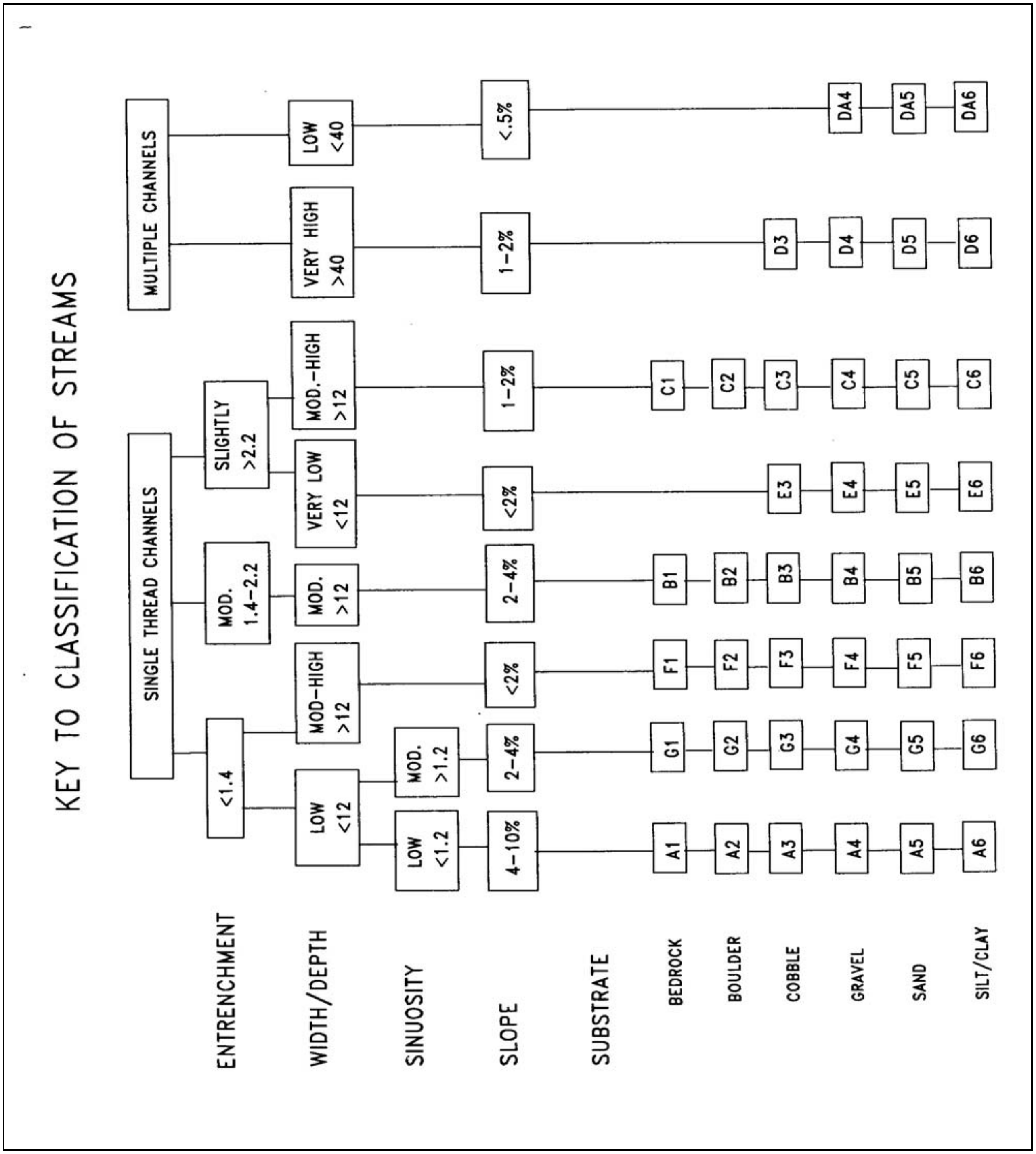


Figure III-5. Key to classification of streams.

STREAM CHANNEL TYPE DESCRIPTIONS AND STRUCTURE SUITABILITY

Water surface slope/gradient, entrenchment, width/depth ratio, and dominant substrate are all determined from measurements taken in the field. Sinuosity can be estimated from a 7.5-minute topographic map by measuring the lengths of the valley and the stream. Each measurement will be discussed in Part III, "Instructions for Completing the Stream Channel Type Work Sheet." After the measurements are taken the channel type can be determined using the key to classification of streams (Figure III-5).

Delineation criteria represent averages from a population of measurements characteristic to a wide variety of stream channels. Deviations of measured values from these average values occur in nature, and represent variability within the range of typical values, as well as variability from region to region. Rosgen (1996) notes that values for entrenchment and sinuosity can vary by + 0.2 units, while width-depth ratios can vary by + 2.0 units without necessarily dictating a change in channel type.

Descriptions of stream channel types, as developed by Rosgen (1994), are presented below as well as lists of habitat improvement structures suitable for use or consideration in each stream channel type (Part VI- Instream Structure Suitability By Stream Type).

Stream Channel Types

A1 **General Description:** Steep, narrow, cascading, step-pool streams; high energy/debris transport associated with depositional soils; very stable bedrock channel.
Entrenchment: Entrenched < 1.4
Water Surface Slope/Gradient: 4-10%
Dominant Substrate Particle Size: Predominantly bedrock.
Width/Depth Ratio: < 12
Sinuosity: < 1.2

Fish Habitat Improvement Structure Suitability: Generally not suitable. High energy streams with stable stream banks, and poor gravel retention capabilities.

A2 **General Description:** Steep, narrow, cascading, step-pool streams; high energy/debris transport associated with depositional soils; boulder channel.
Entrenchment: Entrenched < 1.4
Water Surface Slope/Gradient: 4-10%
Dominant Substrate: Predominantly boulders.
Width/Depth Ratio: < 12
Sinuosity: < 1.2

Fish Habitat Improvement Structure Suitability: Generally not suitable. High energy streams with stable stream banks, and poor gravel retention capabilities.

A3 **General Description:** Steep, narrow, cascading, step-pool streams; high energy/debris transport associated with depositional soils; cobble channel.
Entrenchment: Entrenched < 1.4
Water Surface Slope/Gradient: 4-10%
Dominant Substrate: Predominantly cobble.
Width/Depth Ratio: < 12
Sinuosity: < 1.2

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for plunge weirs; opposing wing-deflectors; and log cover.
- Poor for boulder clusters and single wing-deflectors.

A4 **General Description:** Steep, narrow, cascading, step-pool streams; high energy/debris transport associated with depositional soils; gravel channel.
Entrenchment: Entrenched < 1.4
Water Surface Slope/Gradient: 4-10%
Dominant Substrate: Predominantly gravel.
Width/Depth Ratio: < 12
Sinuosity: < 1.2

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for plunge weirs; opposing wing-deflectors; and log cover.
- Poor for boulder clusters and single wing-deflectors.

A5 **General Description:** Steep, narrow, cascading, step-pool streams; high energy/debris transport associated with depositional soils; sand channel.
Entrenchment: Entrenched < 1.4
Water Surface Slope/Gradient: 4-10%
Dominant Substrate: Predominantly sand.
Width/Depth Ratio: < 12
Sinuosity: < 1.2

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for plunge weirs; opposing wing-deflectors; and log cover.
- Poor for boulder clusters and single wing-deflectors.

A6 **General Description:** Steep, narrow, cascading, step-pool streams; high energy/debris transport associated with depositional soils; silt/clay channel.
Entrenchment: Entrenched < 1.4
Water Surface Slope/Gradient: 4-10%
Dominant Substrate: Predominantly silt/clay.
Width/Depth Ratio: < 12
Sinuosity: < 1.2

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for plunge weirs, opposing wing-deflectors, and log cover.
- Poor for boulder clusters; single wing-deflectors.

B1 **General Description:** Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools; very stable plan and profile; stable banks; bedrock channel.
Entrenchment: Moderately entrenched 1.4 - 2.2
Water Surface Slope/Gradient: 2-4%
Dominant Substrate: Predominantly bedrock.
Width/Depth Ratio: > 12
Sinuosity: > 1.2

Fish Habitat Improvement Structure Suitability:
- Excellent for bank-placed boulders.
- Good for log cover.
- Poor for plunge weirs; single and opposing wing-deflectors; boulder clusters.

B2 **General Description:** Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools; very stable plan and profile; stable banks; boulder channel.
Entrenchment: Moderately entrenched 1.4 - 2.2
Water Surface Slope/Gradient: 2-4%
Dominant Substrate: Predominantly boulders.
Width/Depth Ratio: > 12
Sinuosity: > 1.2

Fish Habitat Improvement Structure Suitability:
- Excellent for plunge weirs; single and opposing wing-deflectors; log cover.

B3 **General Description:** Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools; very stable plan and profile; stable banks; cobble channel.
Entrenchment: Moderately entrenched 1.4 - 2.2
Water Surface Slope/Gradient: 2-4%
Dominant Substrate: Predominantly cobble.
Width/Depth Ratio: > 12
Sinuosity: > 1.2

Fish Habitat Improvement Structure Suitability:

- Excellent for plunge weirs; boulder clusters and bank placed boulder; single and opposing wing-deflectors; log cover.

B4 **General Description:** Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools; very stable plan and profile; stable banks; gravel channel.
Entrenchment: Moderately entrenched 1.4 - 2.2
Water Surface Slope/Gradient: 2-4%
Dominant Substrate: Predominantly gravel.
Width/Depth Ratio: > 12
Sinuosity: > 1.2

Fish Habitat Improvement Structure Suitability:

- Excellent for low-stage plunge weirs; boulder clusters; bank placed boulders; single and opposing wing-deflectors; log cover.

B5 **General Description:** Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools; very stable plan and profile; stable banks; sand channel.
Entrenchment: Moderately entrenched 1.4 - 2.2
Water Surface Slope/Gradient: 2-4%
Dominant Substrate: Predominantly sand.
Width/Depth Ratio: > 12
Sinuosity: > 1.2

Fish Habitat Improvement Structure Suitability:

- Excellent for bank-placed boulders.
- Good for low-stage weir; single and opposing wing-deflectors; channel constrictors; log cover.

B6 **General Description:** Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools; very stable plan and profile; stable banks; silt/clay channel.
Entrenchment: Moderately entrenched 1.4 - 2.2
Water Surface Slope/Gradient: 2-4%
Dominant Substrate: Predominantly silt/clay.
Width/Depth Ratio: > 12
Sinuosity: > 1.2

Fish Habitat Improvement Structure Suitability:
- Excellent for bank-placed boulders; log cover.
- Good for plunge weirs; single and opposing wing-deflectors; channel constrictors.
- Fair for boulder clusters.

C1 **General Description:** Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplain; bedrock channel.
Entrenchment: Slightly entrenched > 2.2
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly bedrock.
Width/Depth Ratio: > 12
Sinuosity: > 1.4

Fish Habitat Improvement Structure Suitability:
- Excellent for bank-placed boulders; and log cover.
- Poor for plunge weirs; boulder clusters; single and opposing wing-deflectors.

C2 **General Description:** Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplain; boulder channel.
Entrenchment: Slightly entrenched > 2.2
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly boulder.
Width/Depth Ratio: > 12
Sinuosity: > 1.4

Fish Habitat Improvement Structure Suitability:
- Good for plunge weirs; single and opposing wing-deflectors; channel constrictors; log cover.

C3 **General Description:** Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplain; cobble channel.
Entrenchment: Slightly entrenched > 2.2
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly cobble.
Width/Depth Ratio: > 12
Sinuosity: > 1.4

Fish Habitat Improvement Structure Suitability:
- Excellent for bank-placed boulders.
- Good for plunge weirs; boulder clusters; single and opposing wing deflectors; log cover.

C4 **General Description:** Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplain; gravel channel.
Entrenchment: Slightly entrenched > 2.2
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly gravel.
Width/Depth Ratio: > 12
Sinuosity: > 1.4

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for plunge weirs; single and opposing wing-deflectors; channel constrictors; log cover.

C5 **General Description:** Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplain; sand channel.
Entrenchment: Slightly entrenched > 2.2
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly sand.
Width/Depth Ratio: > 12
Sinuosity: > 1.4

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for plunge weirs; log cover.
- Poor for boulder clusters; single and opposing wing deflectors.

C6 **General Description:** Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplain; silt/clay channel.
Entrenchment: Slightly entrenched > 2.2
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly silt/clay.
Width/Depth Ratio: > 12
Sinuosity: > 1.4

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders; log cover.
- Fair for plunge weir.
- Poor for boulder clusters; single wing-deflectors and opposing wing-deflectors.

D3 **General Description:** Multiple channels with longitudinal and transverse bars; very wide channel with eroding banks; cobble channel.
Entrenchment: No entrenchment.
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly cobble.
Width/Depth Ratio: > 40
Sinuosity: < 1.1

Fish Habitat Improvement Structure Suitability:
- Fair for bank-placed boulders; single and opposing wing-deflectors; channel constrictors.
- Poor for plunge weirs; boulder clusters; log cover.

D4 **General Description:** Multiple channels with longitudinal and transverse bars; very wide channel with eroding banks; gravel channel.
Entrenchment: No entrenchment.
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly gravel.
Width/Depth Ratio: > 40
Sinuosity: < 1.1

Fish Habitat Improvement Structure Suitability:
- Fair for bank-placed boulders; single and opposing wing-deflectors; channel constrictors.
- Poor for plunge weirs; boulder clusters; log cover.

D5 **General Description:** Multiple channels with longitudinal and transverse bars; very wide channel with eroding banks; sand channel.
Entrenchment: No entrenchment.
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly sand.
Width/Depth Ratio: > 40
Sinuosity: < 1.1

Fish Habitat Improvement Structure Suitability:
- Fair for bank-placed boulders; single and opposing wing-deflectors; channel constrictors.
- Poor for plunge weirs; boulder clusters; log cover.

D6 **General Description:** Braided channel with longitudinal and transverse bars; very wide channel with eroding banks; silt/clay channel.
Entrenchment: No entrenchment.
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly silt/clay.
Width/Depth Ratio: > 40
Sinuosity: < 1.1

Fish Habitat Improvement Structure Suitability:
- Fair for bank-placed boulders; single and opposing wing-deflectors; channel constrictors.
- Poor for plunge weirs; boulder clusters; log cover.

DA4 **General Description:** Multiple channels, narrow and deep with expansive well vegetated floodplain and associated wetlands; very gentle relief with highly variable sinuosities; stable stream banks; gravel channel.
Entrenchment: Low to zero entrenchment > 2.2
Water Surface Slope/Gradient: < 0.5%
Dominant Substrate: Predominantly gravel.
Width/Depth Ratio: < 40
Sinuosity: 1.1 - 1.6

Fish Habitat Improvement Structure Suitability: Generally not suitable.

DA5 **General Description:** Multiple channels, narrow and deep with expansive well vegetated floodplain and associated wetlands; very gentle relief with highly variable sinuosities; stable stream banks; sand channel.
Entrenchment: Low to zero entrenchment > 2.2
Water Surface Slope/Gradient: < 0.5%
Dominant Substrate: Predominantly sand.
Width/Depth Ratio: < 40
Sinuosity: 1.1 - 1.6

Fish Habitat Improvement Structure Suitability: Generally not suitable.

DA6 **General Description:** Multiple channels, narrow and deep with expansive well vegetated floodplain and associated wetlands; very gentle relief with highly variable sinuosities; stable stream banks; silt/clay channel.
Entrenchment: Low to zero entrenchment > 2.2
Water Surface Slope/Gradient: < 0.5%
Dominant Substrate: Predominantly silt/clay.
Width/Depth Ratio: < 40
Sinuosity: 1.1 - 1.6

Fish Habitat Improvement Structure Suitability: Generally not suitable.

E3 **General Description:** Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition; very efficient and stable; high meander width ratio; cobble channel.
Entrenchment: Slight entrenchment > 2.2
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly cobbles.
Width/Depth Ratio: < 12
Sinuosity: > 1.5

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for opposing wing-deflectors.
- Poor for plunge weirs; boulder clusters; single wing-deflectors.

E4 **General Description:** Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition; very efficient and stable; high meander width ratio; gravel channel.
Entrenchment: Slight entrenchment > 2.2
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly gravel.
Width/Depth Ratio: < 12
Sinuosity: > 1.5

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for opposing wing-deflectors.
- Poor for plunge weirs; boulder clusters; single wing-deflectors.

E5 **General Description:** Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition; very efficient and stable; high meander width ratio; sand channel.
Entrenchment: Slight entrenchment > 2.2
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly sand.
Width/Depth Ratio: < 12
Sinuosity: > 1.5

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for opposing wing-deflectors.
- Poor for plunge weirs; boulder clusters; single wing-deflectors.

E6 **General Description:** Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition; very efficient and stable; high meander width ratio; silt/clay channel.
Entrenchment: Slight entrenchment > 2.2
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly silt/clay.
Width/Depth Ratio: < 12
Sinuosity: > 1.5

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for opposing wing-deflectors.
- Poor for plunge weirs; boulder clusters; single wing-deflectors.

F1 **General Description:** Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio; very stable if bedrock controlled channel.
Entrenchment: Well entrenched < 1.4
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly bedrock.
Width/Depth Ratio: > 12
Sinuosity: > 1.4

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for single wing-deflectors; log cover.
- Poor for plunge weirs; boulder clusters; opposing wing deflectors.

F2 **General Description:** Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio; boulder channel.
Entrenchment: Well entrenched < 1.4
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly boulders.
Width/Depth Ratio: > 12
Sinuosity: > 1.4

Fish Habitat Improvement Structure Suitability:
- Fair for plunge weirs; single and opposing wing-deflectors; log cover.

F3 **General Description:** Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio; cobble channel.
Entrenchment: Well entrenched < 1.4
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly cobble.
Width/Depth Ratio: > 12
Sinuosity: > 1.4

Fish Habitat Improvement Structures Suitability:
- Good for bank-placed boulders; single and opposing wing-deflectors.
- Fair for plunge weirs; boulder clusters; channel constrictors; log cover.

F4 **General Description:** Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio; gravel channel.
Entrenchment: Well entrenched < 1.4
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly gravel.
Width/Depth Ratio: > 12
Sinuosity: > 1.4

Fish Habitat Improvement Structures Suitability:

- Good for bank-placed boulders.
- Fair for plunge weirs; single and opposing wing-deflectors; channel constrictors; log cover.
- Poor for boulder clusters.

F5 **General Description:** Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio; sand channel.
Entrenchment: Well entrenched < 1.4
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly sand.
Width/Depth Ratio: > 12
Sinuosity: > 1.4

Fish Habitat Improvement Structure Suitability:

- Good for bank-placed boulders.
- Fair for plunge weirs; single and opposing wing-deflectors; channel constrictors; log cover.
- Poor for boulder clusters.

F6 **General Description:** Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio; silt/clay channel.
Entrenchment: Well entrenched < 1.4
Water Surface Slope/Gradient: < 2%
Dominant Substrate: Predominantly silt/clay.
Width/Depth Ratio: > 12
Sinuosity: > 1.4

Fish Habitat Improvement Structure Suitability:

- Good for bank-placed boulders.
- Fair for plunge weirs; boulder clusters; single and opposing wing deflectors; log cover.

G1 **General Description:** Entrenched "gully" step-pool and low width/depth ratio on moderate gradient; stable if in a bedrock controlled channel.
Entrenchment: Well entrenched < 1.4
Water Surface Slope/Gradient: 2-4%
Dominant Substrate: Predominantly bedrock.
Width/Depth Ratio: < 12
Sinuosity: > 1.2

Fish Habitat Improvement Structure Suitability:
- Fair for log cover.
- Poor for boulder clusters.

G2 **General Description:** Entrenched "gully" step-pool and low width/depth ratio on moderate gradient.
Entrenchment: Well entrenched < 1.4
Water Surface Slope/Gradient: 2-4%
Dominant Substrate: Predominantly boulders.
Width/Depth Ratio: < 12
Sinuosity: > 1.2

Fish Habitat Improvement Structure Suitability:
- Fair for log cover.

G3 **General Description:** Entrenched "gully" step-pool and low width/depth ratio on moderate gradient.
Entrenchment: Well entrenched < 1.4
Water Surface Slope/Gradient: 2-4%
Dominant Substrate: Predominantly cobble.
Width/Depth Ratio: < 12
Sinuosity: > 1.2

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for plunge weirs; opposing wing-deflectors; log cover.
- Poor for boulder clusters; single wing-deflectors.

G4 **General Description:** Entrenched "gully" step-pool and low width/depth ratio on moderate gradient.
Entrenchment: Well entrenched < 1.4
Water Surface Slope/Gradient: 2-4%
Dominant Substrate: Predominantly gravel.
Width/Depth Ratio: < 12
Sinuosity: > 1.2

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for plunge weirs; opposing wing-deflectors; log cover.
- Poor for boulder clusters; single wing-deflectors.

G5 **General Description:** Entrenched "gully" step-pool and low width/depth ratio on moderate gradient.
Entrenchment: Well entrenched < 1.4
Water Surface Slope/Gradient: 2-4%
Dominant Substrate: Predominantly sand.
Width/Depth Ratio: < 12
Sinuosity: > 1.2

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for plunge weirs; opposing wing-deflectors; log cover.
- Poor for boulder clusters; single wing-deflectors.

G6 **General Description:** Entrenched "gully" step-pool and low width/depth ratio on moderate gradient.
Entrenchment: Well entrenched < 1.4
Water Surface Slope/Gradient: 2-4%
Dominant Substrate: Predominantly silt/clay.
Width/Depth Ratio: < 12
Sinuosity: > 1.2

Fish Habitat Improvement Structure Suitability:
- Good for bank-placed boulders.
- Fair for plunge weirs; opposing wing-deflectors; log cover.
- Poor for boulder clusters; single wing-deflectors.

STREAM CHANNEL TYPE WORK SHEET

A Stream Channel Type Work Sheet is filled out at the beginning of the survey and each time the channel type changes. Significant changes in stream gradient, flood plain width, width/depth ratio, sinuosity or substrate size all indicate possible changes in channel type. The habitat unit number corresponding with the beginning and ending of each new channel type should be recorded on the Stream Channel Type Work Sheet and accompanying topographical field map. Field measurements for stream types are conducted at velocity crossover areas. Water surface slope measurements are taken between two points that are at least 20 bankfull channel widths apart. Velocity crossover areas occur where stream velocity changes from slower flatwater or pool velocities to the swifter riffle velocities. These crossover areas are typically found where the thalweg of the stream crosses from one side of the channel to the other (Figure III-6). Further, stream types should be determined at points where the channel geometry is not affected by outside influences. Outside influences include road embankments, riprap, landslides, tributaries, etc.

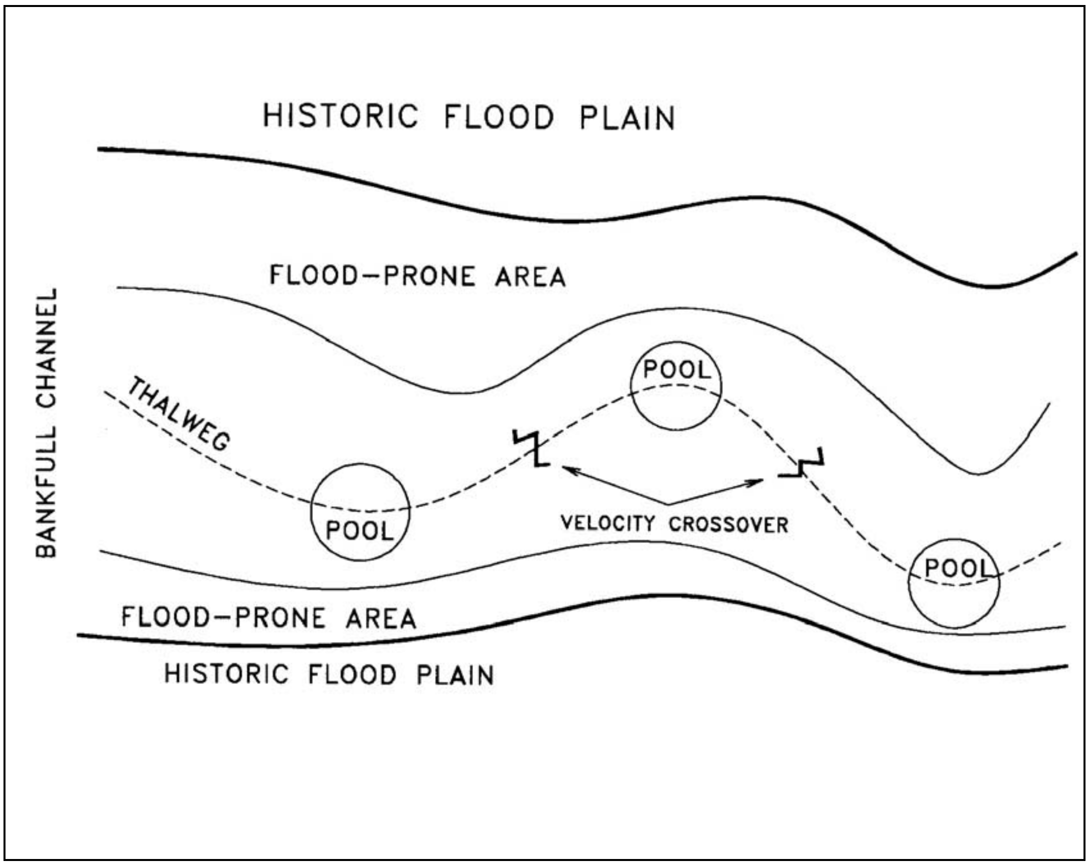


Figure III-6. Velocity crossover areas.

Instructions for Completing the Stream Channel Type Work Sheet

A channel type unit length must extend over a distance at least twenty times the average bankfull width.

1) **Form No.** - Print in the form number. Number the forms sequentially beginning with "01" on the first page,"02" on the second, and so on.

2) **Channel Type** - Enter the channel type code from the completed work sheet.

3) **Channel Change Location** - Enter the habitat unit # where the channel change occurred from the corresponding Habitat Inventory Data Form.

4) **Cross-Section Location** - Enter the habitat unit number at the location of the cross section.

5) **Date** - Enter the day's date: mm/dd/yy.

6) **Stream** - Print in the stream name.

7) **T-R-S** - Enter the township, range and section of the stream confluence. This information can be obtained from a USGS quadrangle.

8) **Surveyors** - Enter the names of the surveyors.

9) **Quad** - Enter the name(s) of the 7.5-minute USGS topographic map(s).

10) **Latitude** - Enter the stream's latitude in degrees, minutes, and seconds from the Watershed Overview Work Sheet. These positions can be obtained using a Global Positioning System (GPS) receiver, a GIS computer program, or a latitude and longitude calculator (Coordinator brand). (Appendix M).

11) **Longitude** - Enter the stream's longitude in degrees, minutes, and seconds from the Watershed Overview Work Sheet. These positions can be obtained using a Global Positioning System (GPS) receiver, a GIS computer program, or a latitude and longitude calculator (Coordinator brand). (Appendix M).

12) **Determination of Number of Channels** - Determine if the channel type reach is dominated by either a single thread or multiple channel(s) at bankfull discharge.

13) **Bankfull Width (W_{bkf})** - Measure the width of the stream at bankfull discharge (Q_{bkf}). Bankfull width is measured by stretching a level tape from one bank to the other, perpendicular to the stream and at the Q_{bkf} line of demarcation on each bank. Q_{bkf} is determined by changes in substrate composition, bank slope, and perennial vegetation caused by frequent scouring flows.

14) **Transect Recording Box -** This form is used to record depths and substrate composition from 20 stations equally spaced along a fiberglass measuring tape stretched across the channel at bankfull width. The distances at which measurements are made are recorded in the recording box=s top row titled “Dist.”. Measurements are taken along the tape line starting at zero at each predetermined distance point. Depths are the distance from the tape to the channel substrate below, and are recorded in the middle row titled “Depth.” Twenty substrate samples are collected at the equidistant sample points along the distance of the tape by selecting the substrate particle first touched by the stadia rod. The code number for the corresponding substrate sampled is then recorded in the row titled “Sub.”

15) **Dominant Substrate Determination** - When all 20 substrate samples have been collected, the number of samples of each substrate size are added and the totals are recorded in the summary section. The substrate most frequently sampled is the dominant substrate type.

16) **Entrenchment Determination** - (Figure III-7)

Step One: **Flood-Prone Width Elevation -** Multiply the deepest bankfull depth recorded in the Transect Recording Box by two.

Step Two: **Flood-Prone Width (W_{FP}) -** Establish a level plane at an elevation twice the maximum bankfull depth and measure the distance between the points where the plane intersects the stream banks.

Step Three: **Entrenchment Determination -** Divide the flood prone width by the bankfull width to determine the entrenchment of the channel.

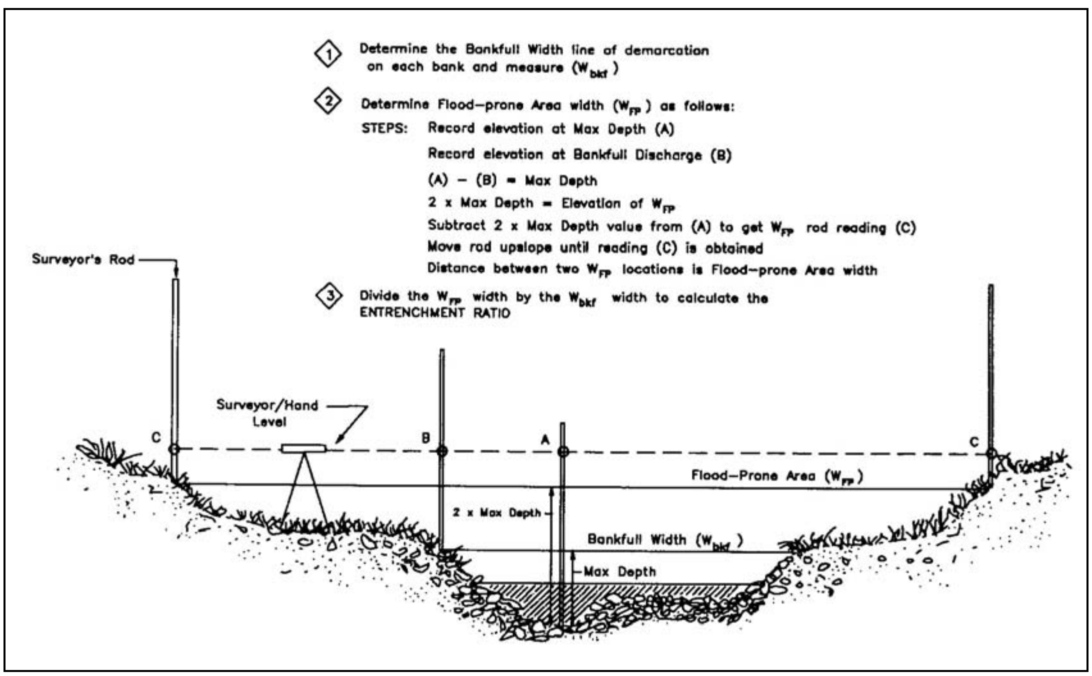


Figure III-7. Entrenchment determination.

17) **Width/Depth Determination -**

Step One: **Mean Bankfull Depth (d_{bkf})** - Divide the sum of depths from the transect recording box by the number of depths measured.

Step Two: **Width/Depth Determination** - Divide the bankfull width by mean bankfull depth to determine the width/depth ratio.

18) **Sinuosity** - Determine the ratio between stream length and valley length. These lengths can be calculated from 7.5-minute USGS topographic maps or aerial photographs using a map wheel. Sinuosity ratio is only used to distinguish A from G channel types.

19) **Water Surface Slope Determination** - To determine stream gradient, establish two survey stations along the stream at least twenty bankfull widths apart, and located at velocity crossover locations. Station elevations are set at the level of the water surface on either side of the stream. A sight level is used to determine the difference in elevation between the stadia rods. The horizontal distance between the stations is measured along the thalweg of the stream. The elevation difference is divided by the horizontal distance and multiplied by 100 to express water surface slope in percentile.

STREAM CHANNEL TYPE WORK SHEET

Form # ____ of ____

Channel Type ______ **Channel Change Location (Habitat Unit#)** ________________________________
Cross-Section Location (Habitat Unit#) ____________________________ **Date** ______/_____/_____
Stream ____
T_____**R**_____**S**_____ **Surveyors** ____
Quad ______________________________________ **Lat** _____ ____ ____ **Long** _____ ____ ____

Single Thread Channel ________ (Y/N) **Multiple Channel** ________ (Y/N)

Bankfull Width (W_{bkf}) = _________ (ft.)

Transect Recording Box

Dist.																				
Depth																				
Sub.																				

Sum of Depths ____________

Dominant Substrate Determination:

	Substrate:	Number	
1.	Bedrock	= _____	
2.	Boulder (>10")	= _____	(Circle Most
3.	Cobble (2.5 - 10")	= _____	Frequent
4.	Gravel (0.08 - 2.5")	= _____	Occurrence)
5.	Sand (<0.08)	= _____	
6.	Silt / Clay	= _____	

Entrenchment Determination:

Step 1: Maximum Bankfull Depth ________________ x 2 = ______________ (W_{FP} Elev.)

Step 2: Determine Flood-Prone Width at WFP Elevation = ___________________ (W_{FP})

Step 3: Flood-Prone Width (W_{FP}) / Bankfull Width (W_{bkf}) = Entrenchment
W_{FP} ___________ (ft.) / _____________ (ft.) = __________ **(Entrenchment)**

Width/Depth Determination:

Step 1: Sum of Depths ______ / No. Depths _______ = Mean Bankfull Depth (d_{bkf}) ____

Step 2: Bankfull Width (W_{bkf}) / Mean Bankfull Depth (d_{bkf})=Width/Depth Ratio
W_{bkf} ___________ (ft.) / d_{bkf} __________ (ft.) = _____________ **(W/D Ratio)**

Sinuosity Determination (Only For A or G Types):

Stream Length ____________ / Valley Length ___________ = Sinuosity ________________

Water surface slope Determination:

Downstream Level - Upstream Level / Distance (D) = Energy Gradient
DSL ________ (ft.) - USL __________ (ft.) / (D) __________ (ft.) = _________________________

HABITAT TYPING

The habitat typing procedure presented is a standardized methodology that physically describes 100 percent of the wetted channel. It is a composite of systems principally developed or modified by other investigators and compiled in part by Trinity Fisheries Consulting on contract to DFG.

Habitat types are described according to location, orientation, and water flow. The attributes distinguishing the various habitat types include over-all channel gradient, velocity, depth, substrate, and the channel features responsible for the unit's formation.

A basin-level habitat inventory is designed to produce a thorough description of the physical fish habitat. Basin-level habitat classification is on the scale of a stream's naturally occurring pool-riffle-run units. The length of a habitat unit depends on stream size and order. For basin-level habitat inventory, homogeneous areas of habitat that are equal or greater in length than one wetted channel width are recognized as distinct habitat units. During basin-level habitat typing, full sampling of each habitat unit requires recording all characteristics of each habitat unit as per the "Instructions for completing the Habitat Inventory Data Form" (Part III). After DFG analysis of over 200 stream habitat inventory data sets, it was determined that similar stream descriptive detail could be accomplished with a sampling level of approximately 10 percent (Appendix O).

The information provided by habitat and channel typing, and biological information collected during spawning surveys and/or juvenile rearing surveys aids in determining if critical habitat needs of a target species are lacking, and if there are areas where improvements can be made.

There are four levels of classification used to describe physical fish habitat. Each higher level in the sequence includes more descriptive categories of habitat types (Figure III-8). Level I categorizes habitat into riffles or pools. Level II categorizes riffles into riffle or flatwater habitat types, for a total of three types (riffle, pool, and flatwater). Level III further differentiates riffle types on the basis of water surface gradient (riffle or cascade), and pool types according to their location in the stream channel (main channel, lateral scour, or backwater). At Level IV, pools are categorized by the cause of formation (obstruction, blockage, constriction, or merging flows); riffles are categorized by gradient; and cascades by gradient and substrate type; and flatwaters are categorized by depth and velocity. Level IV habitat types are the 24 habitat types listed on page III-30 and diagramed on pages III-31 through III-42.

Prior to conducting an inventory, the level of data collection necessary to meet the needs of the investigation should be established. Habitat typing at Level IV will provide the greatest detail and the most complete description of existing habitat. This data can later be aggregated into broader levels of habitat classification if detail is found to be excessive.

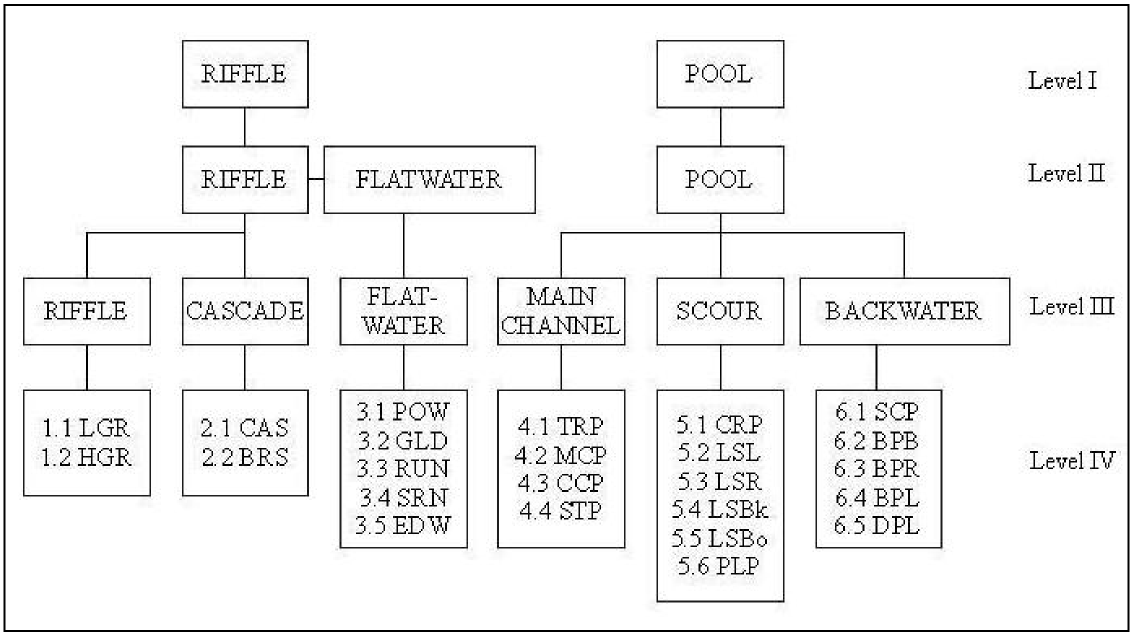


Figure III-8. Habitat types hierarchy.

Generally a stream will not contain all 24 habitat types. The mix of habitat types will be reflective of the overall channel gradient, flow regime, cross-sectional profile, and substrate particle size. Basins that exhibit a wide range in channel gradient will also have a broad mix of habitat types. Stratifying a basin by channel types helps to predict the location of certain habitat types.

Project-level habitat typing is used to evaluate and quantify changes in habitat as the result of fish habitat restoration/enhancement projects. It will provide insight on the relationship between channel features and habitat development. For project-level habitat typing, the minimum size of a habitat unit is equal to the width of the wetted stream channel. For a more detailed habitat analysis, the units can be reduced. The habitat unit size used depends on the nature and objective of the particular study. Regardless of unit size, Level IV habitat types should be used.

Habitat typing is intended to yield detailed information that can be used for fisheries management. Basin-wide habitat typing can provide a variety of data. Some important applications are:

- Physically describe 100 percent of the habitat in a basin.
- Provide baseline data to evaluate habitat responses to restoration efforts.
- Facilitate restoration planning and fisheries management.
- Determine transect locations for Instream Flow Incremental Methodology (IFIM) modeling based on habitat availability and accessibility.

Definition of Habitat Types

The following list of habitat types and their hierarchy has been adapted from the original system developed by Bisson, et al. (1982), modified by Decker, Overton, et al. (1985), and Sullivan (1988).

Level I Habitat Types:

RIFFLE:
(Riffle, Cascade, Flatwater)
POOL:
(Main Channel Pool, Scour Pool, Backwater Pool)

Level II Habitat Types:

RIFFLE:
(Low-Gradient Riffle, High-Gradient Riffle, Cascade, Bedrock Sheet)
FLATWATER:
(Pocket Water, Run, Step Run, Glide, Edgewater)
POOL:
(Plunge Pool, Mid-Channel Pool, Dammed Pool, Step Pool, Channel Confluence Pool, Trench Pool, Lateral Scour Pool - Root Wad Enhanced, Boulder Formed, Bedrock Formed, and Log Enhanced, Corner Pool, Secondary Channel Pool, Backwater Pool - Boulder Formed, Root Wad Formed, and Log Formed)

Level III and Level IV Habitat Types:

The three or four letter abbreviations in parentheses, (***), are the standardized abbreviations adopted by DFG. The three digit numbers in brackets, [*.*], are the standardized numbers adopted by DFG. The numbers in braces, {**}, are the numbers listed in the *Pacific Southwest Region Habitat Typing Field Guide*, USDA-USFS. Table on next page.

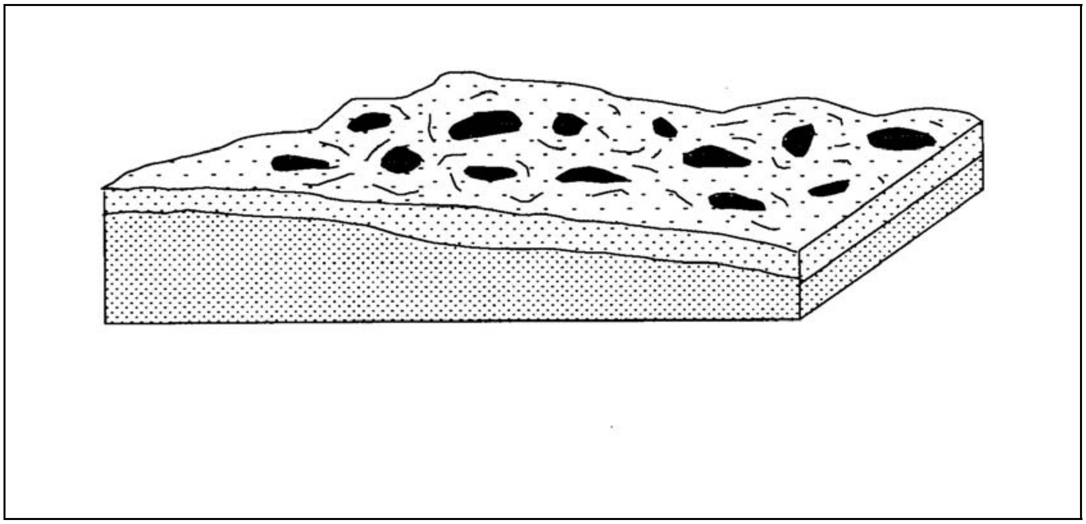
LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE			
Low Gradient Riffle	(LGR)	[1.1]	{1}
High Gradient Riffle	(HGR)	[1.2]	{2}
CASCADE			
Cascade	(CAS)	[2.1]	{3}
Bedrock Sheet	(BRS)	[2.2]	{24}
FLATWATER			
Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}
MAIN CHANNEL POOL			
Trench Pool	(TRP)	[4.1]	{8}
Mid-Channel Pool	(MCP)	[4.2]	{17}
Channel Confluence Pool	(CCP)	[4.3]	{19}
Step Pool	(STP)	[4.4]	{23}
SCOUR POOL			
Corner Pool	(CRP)	[5.1]	{22}
L. Scour Pool - Log Enhanced	(LSL)	[5.2]	{10}
L. Scour Pool - Root Wad Enhanced	(LSR)	[5.3]	{11}
L. Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{12}
L. Scour Pool - Boulder Formed	(LSBo)	[5.5]	{20}
Plunge Pool	(PLP)	[5.6]	{9}
BACKWATER POOLS			
Secondary Channel Pool	(SCP)	[6.1]	{4}
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{5}
Backwater Pool - Root Wad Formed	(BPR)	[6.3]	{6}
Backwater Pool - Log Formed	(BPL)	[6.4]	{7}
Dammed Pool	(DPL)	[6.5]	{13}
ADDITIONAL UNIT DESIGNATIONS			
Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	

Level IV Habitat Type Descriptions:

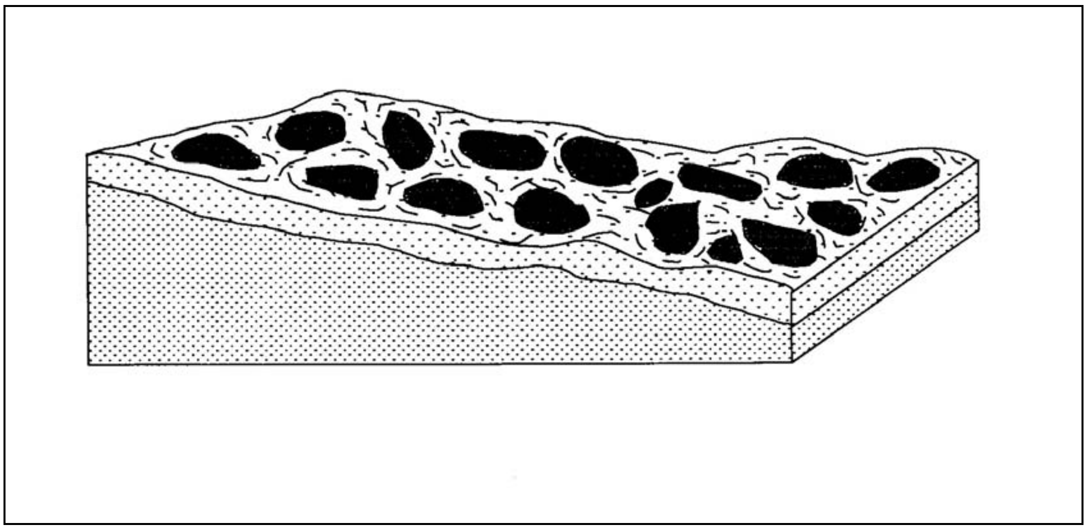
The following habitat type descriptions are taken from the *Pacific Southwest Region Habitat Typing Field Guide*, USDA-USFS.

LOW-GRADIENT RIFFLE (LGR) [1.1] {1}



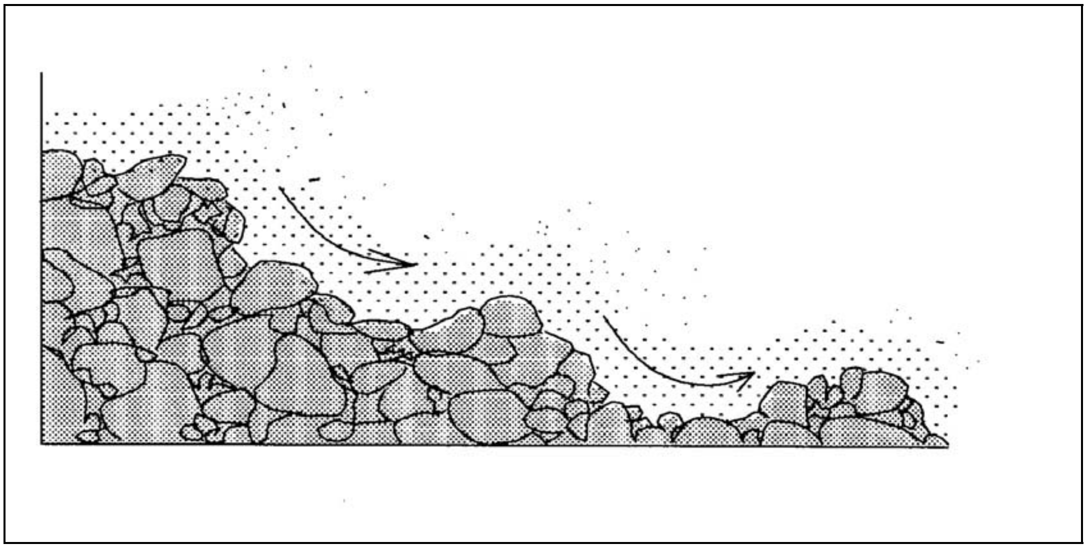
Shallow reaches with swiftly flowing, turbulent water with some partially exposed substrate. Gradient < 4%, substrate is usually cobble dominated.

HIGH-GRADIENT RIFFLE (HGR) [1.2] {2}



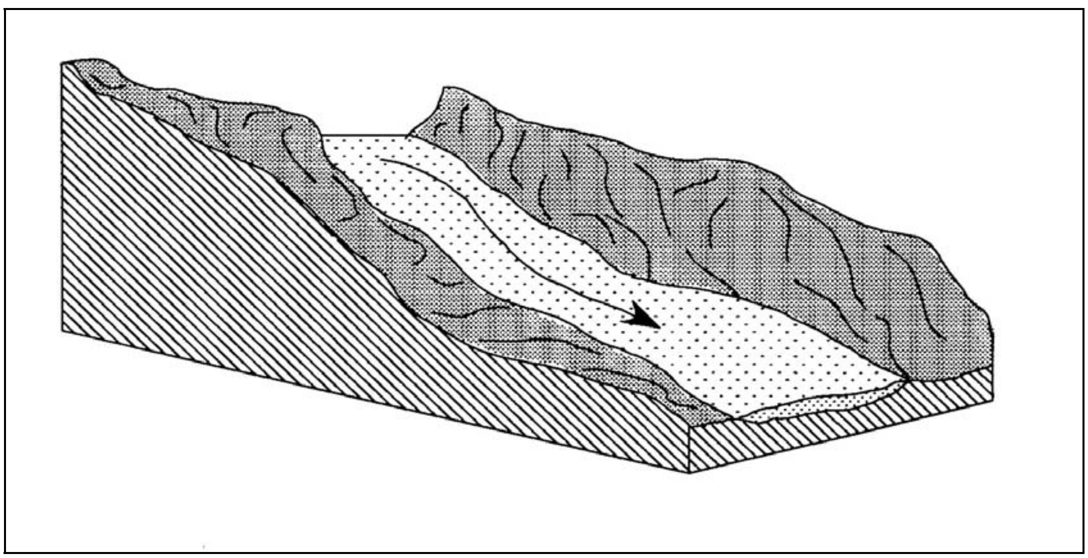
Steep reaches of moderately deep, swift, and very turbulent water. Amount of exposed substrate is relatively high. Gradient is > 4%, and substrate is boulder dominated.

CASCADE (CAS) [2.1] {3}



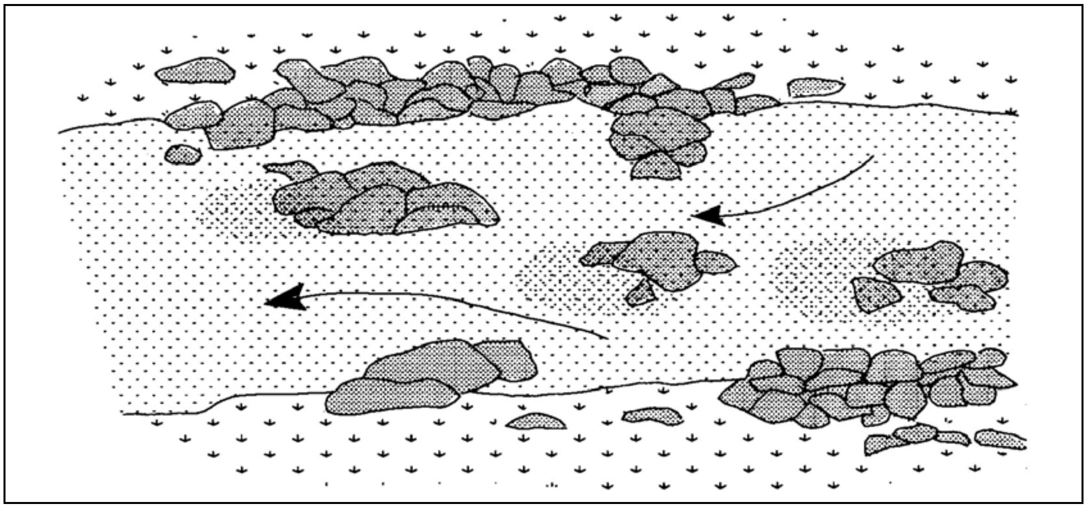
The steepest riffle habitat, consisting of alternating small waterfalls and shallow pools. Substrate is usually bedrock and boulders.

BEDROCK SHEET (BRS) [2.2] {24}



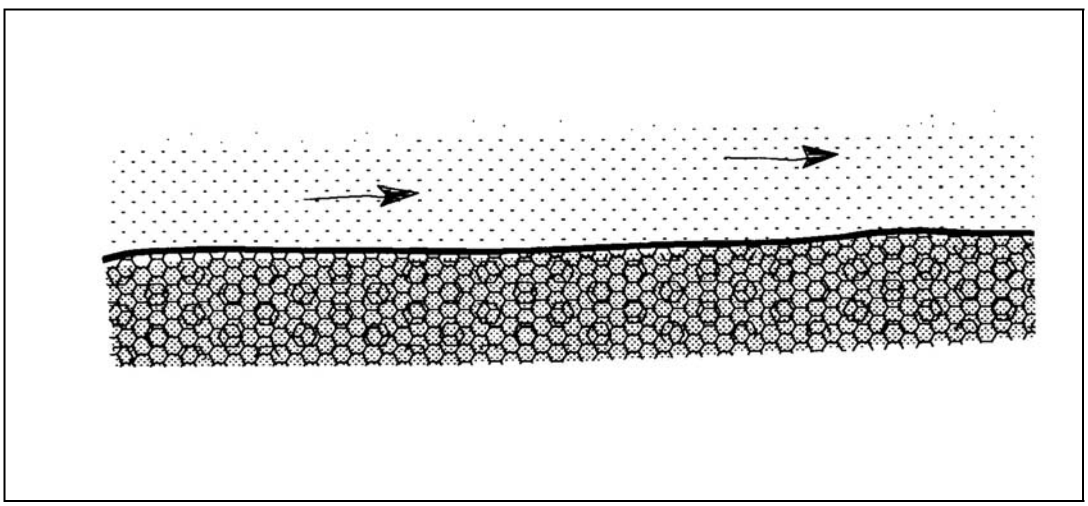
A thin sheet of water flowing over a smooth bedrock surface. Gradients are highly variable.

POCKET WATER (POW) [3.1] {21}



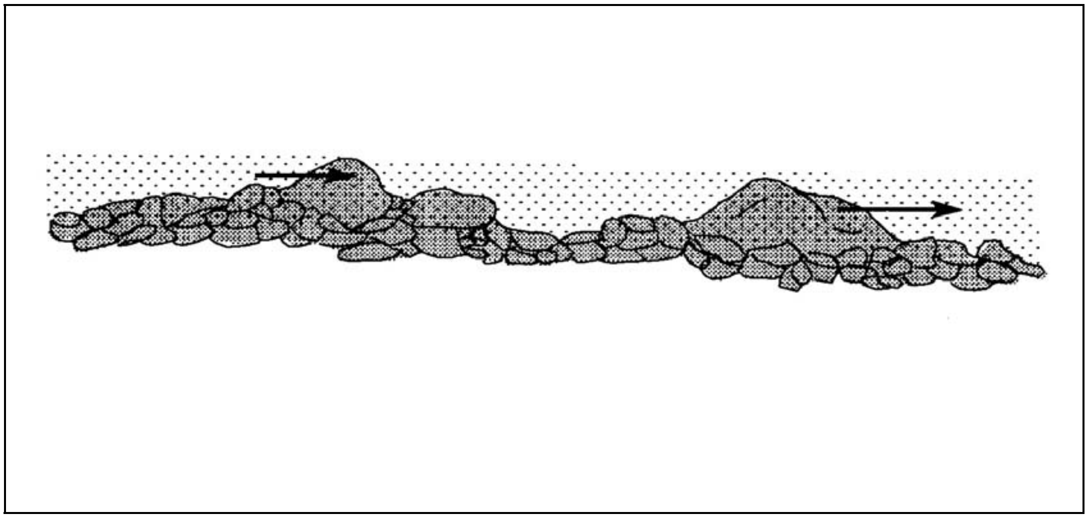
A section of swift-flowing stream containing numerous boulders or other large obstructions which create eddies or scour holes (pockets) behind the obstructions.

GLIDE (GLD) [3.2] {14}



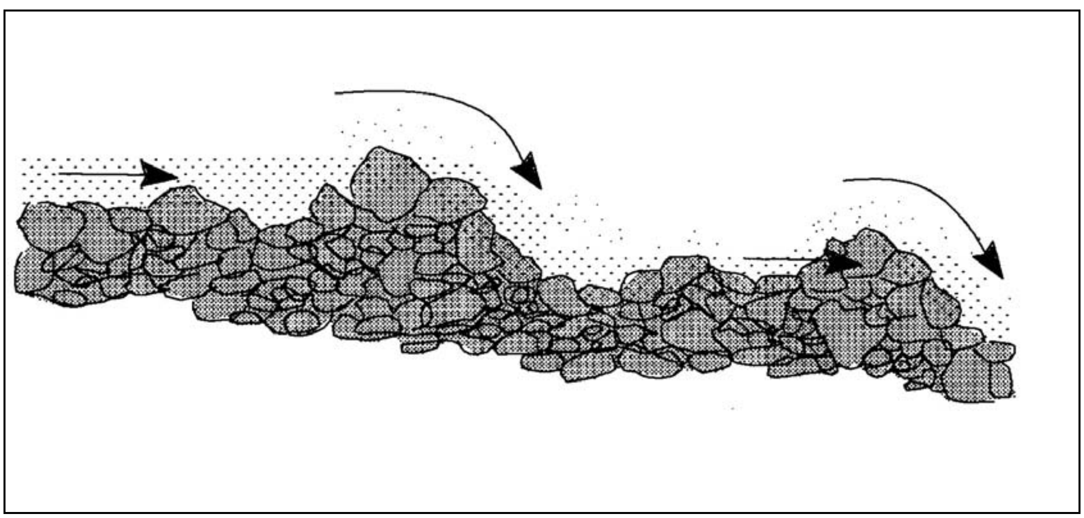
A wide, uniform channel bottom. Flow with low to moderate velocities, lacking pronounced turbulence. Substrate usually consists of cobble, gravel, and sand.

RUN (RUN) [3.3] {15}



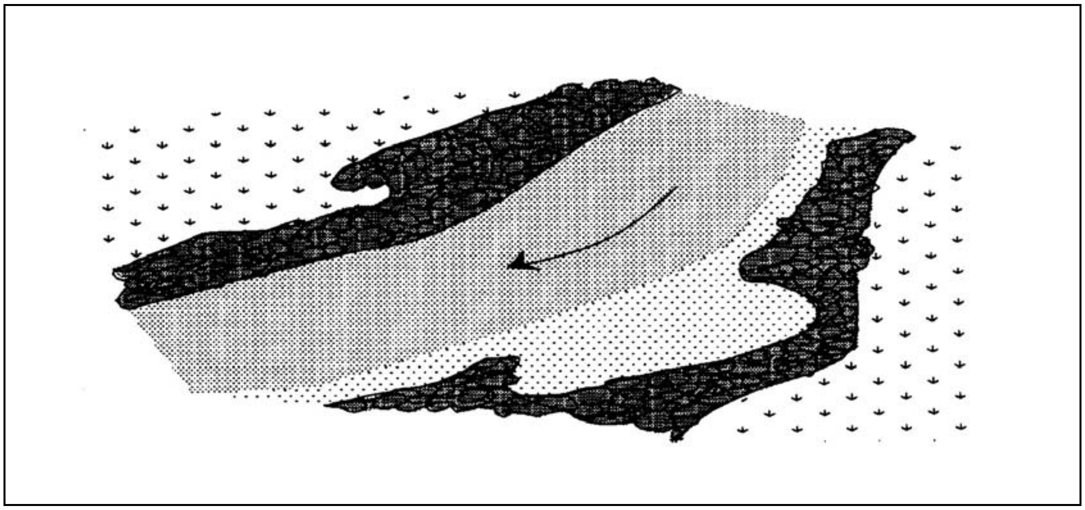
Swiftly flowing reaches with little surface agitation and no major flow obstructions. Often appears as flooded riffles. Typical substrate consists of gravel, cobble, and boulders.

STEP RUN (SRN) [3.4] {16}



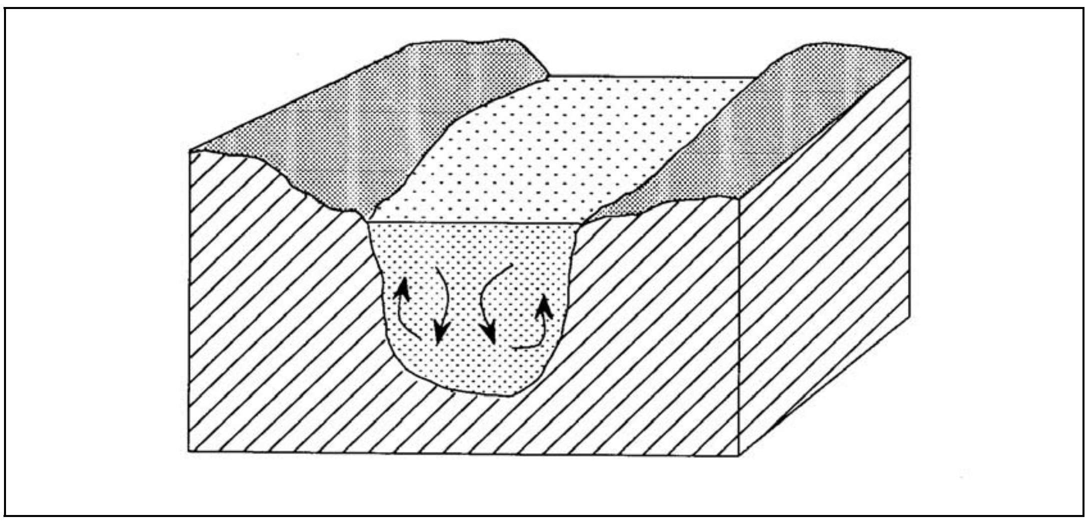
A sequence of runs separated by short riffle steps. Substrate is usually cobble and boulder dominated.

EDGEWATER (EDW) [3.5] {18}



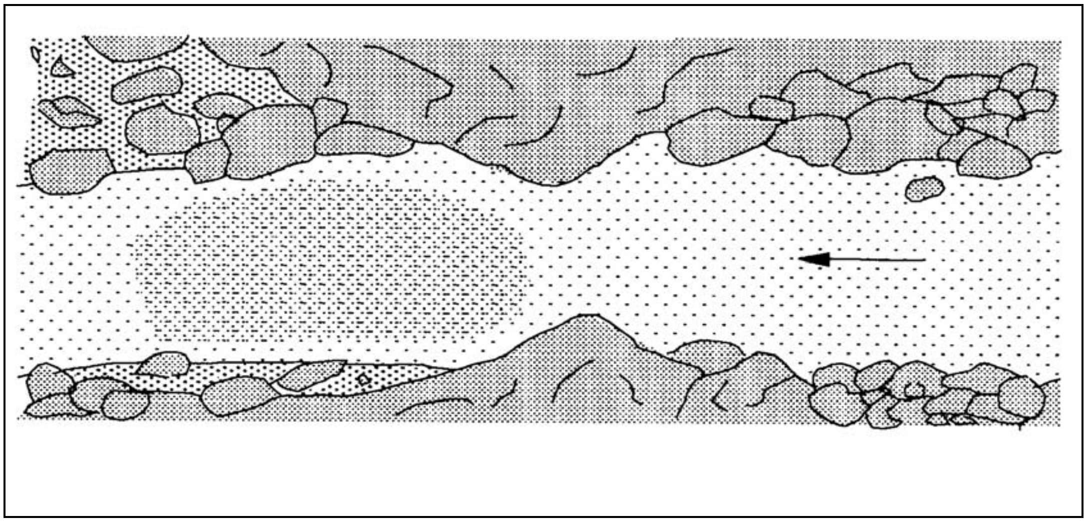
Quiet, shallow area found along the margins of the stream, typically associated with riffles. Water velocity is low and sometimes lacking. Substrate varies from cobbles to boulders.

TRENCH POOLS (TRP) [4.1] {8}



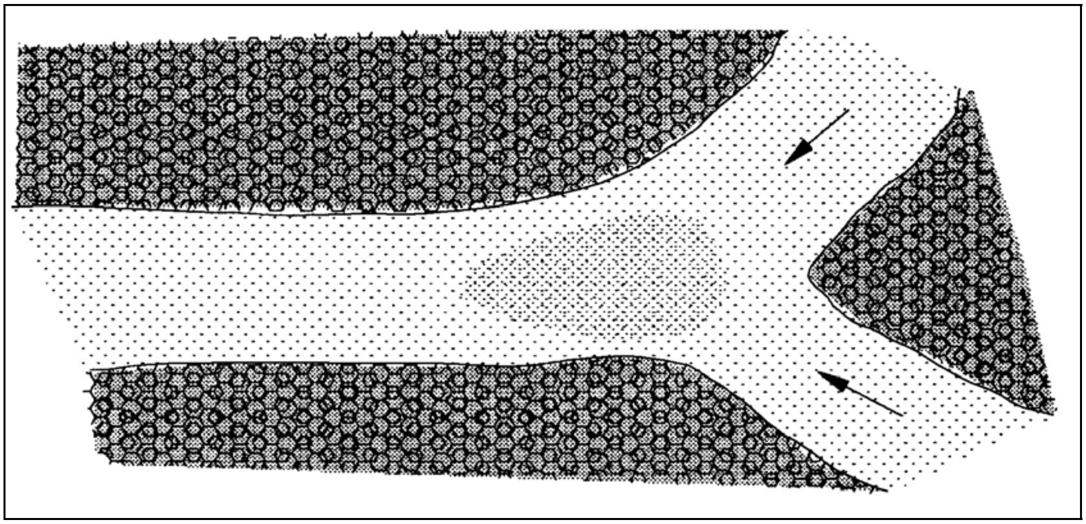
Channel cross sections typically U-shaped with bedrock or coarse grained bottom flanked by bedrock walls. Current velocities are swift and the direction of flow is uniform.

MID-CHANNEL POOL (MCP) [4.2] {17}



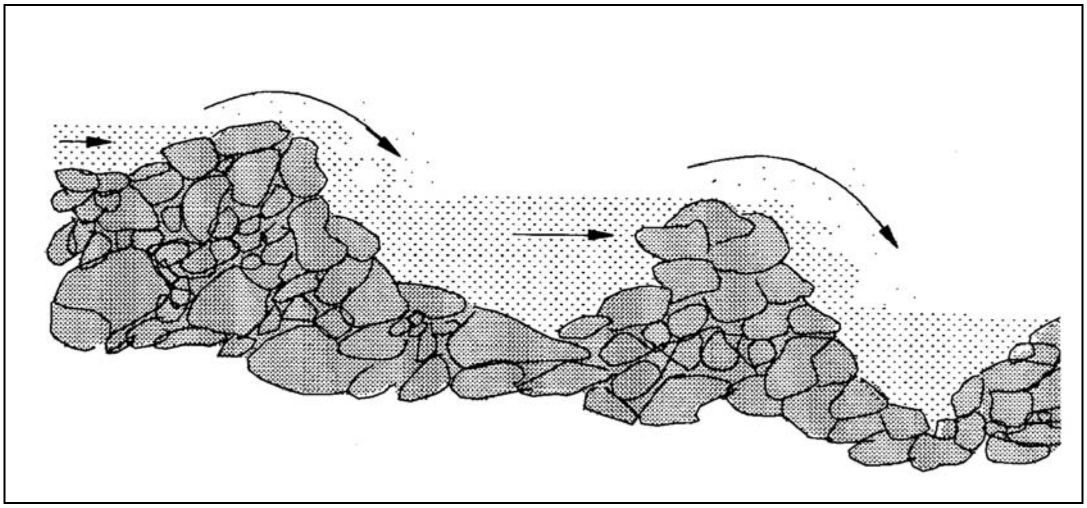
Large pools formed by mid-channel scour. The scour hole encompasses more than 60% of the wetted channel. Water velocity is slow, and the substrate is highly variable.

CHANNEL CONFLUENCE POOL (CCP) [4.3] {19}



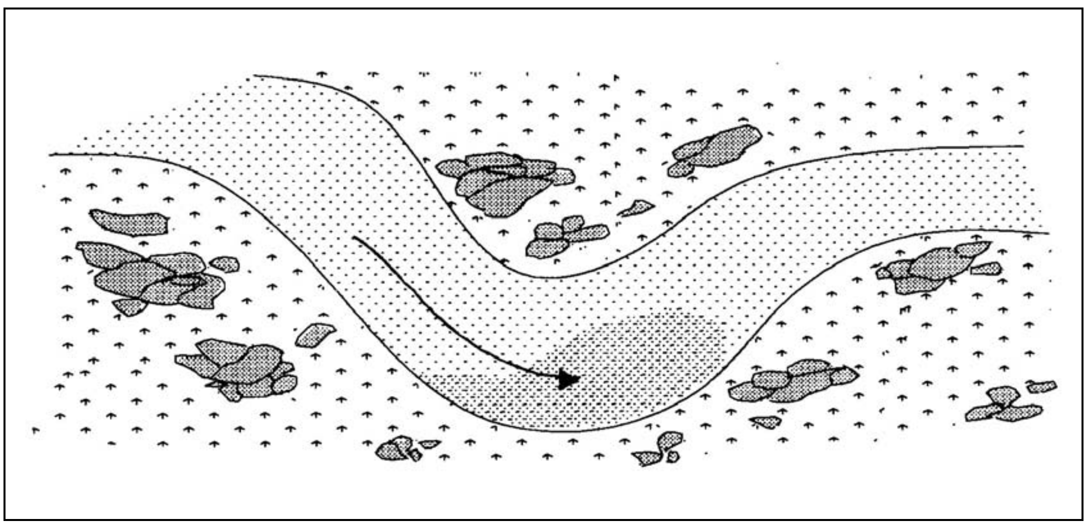
Large pools formed at the confluence of two or more channels. Scour can be due to plunges, lateral obstructions or scour at the channel intersections. Velocity and turbulence are usually greater than those in other pool types.

STEP POOL (STP) [4.4] {23}



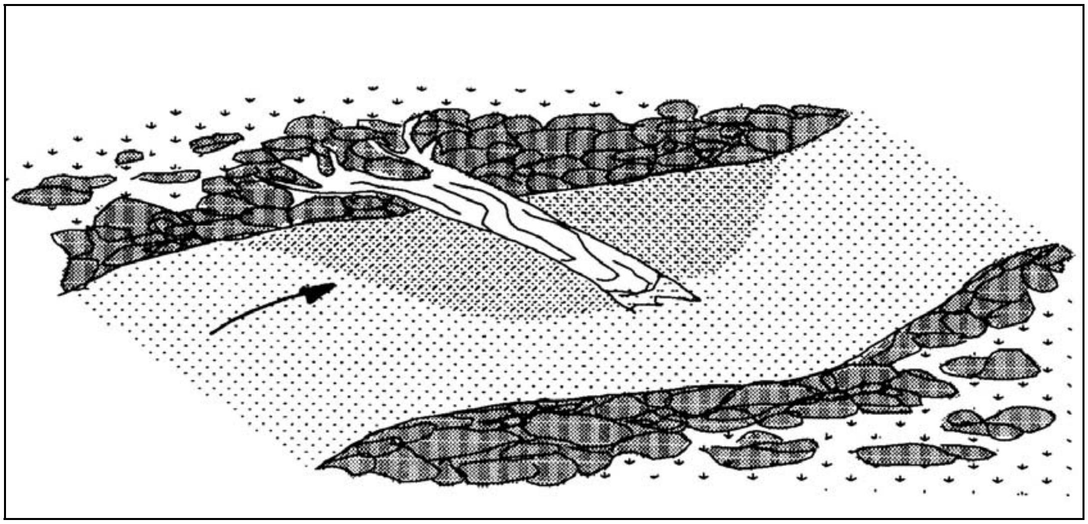
A series of pools separated by short riffles or cascades. Generally found in high-gradient, confined mountain streams dominated by boulder substrate.

CORNER POOL (CRP) [5.1] {22}



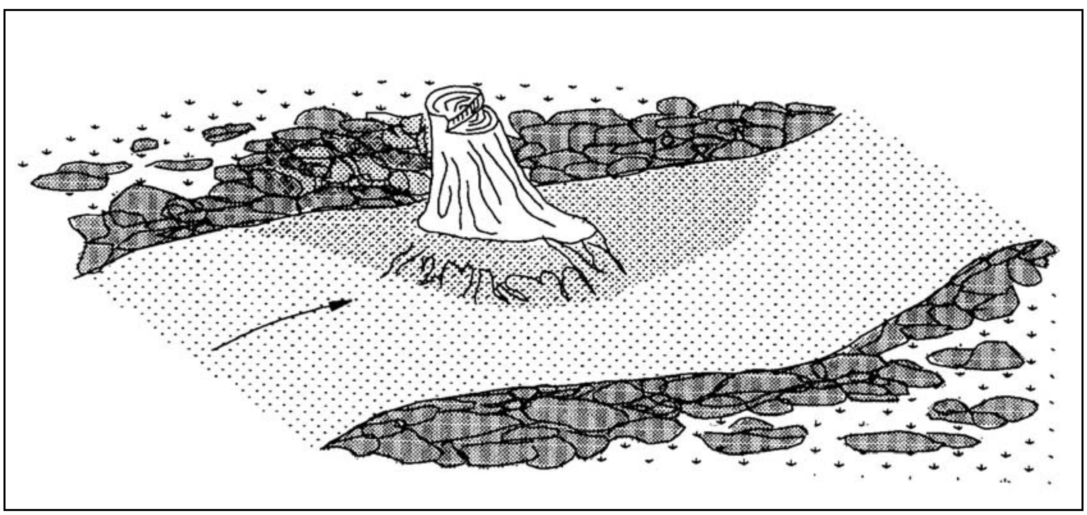
Lateral scour pools formed at a bend in the channel. These pools are common in lowland valley bottoms where stream banks consist of alluvium and lack hard obstructions.

LATERAL SCOUR POOL - LOG ENHANCED (LSL) [5.2] {10}



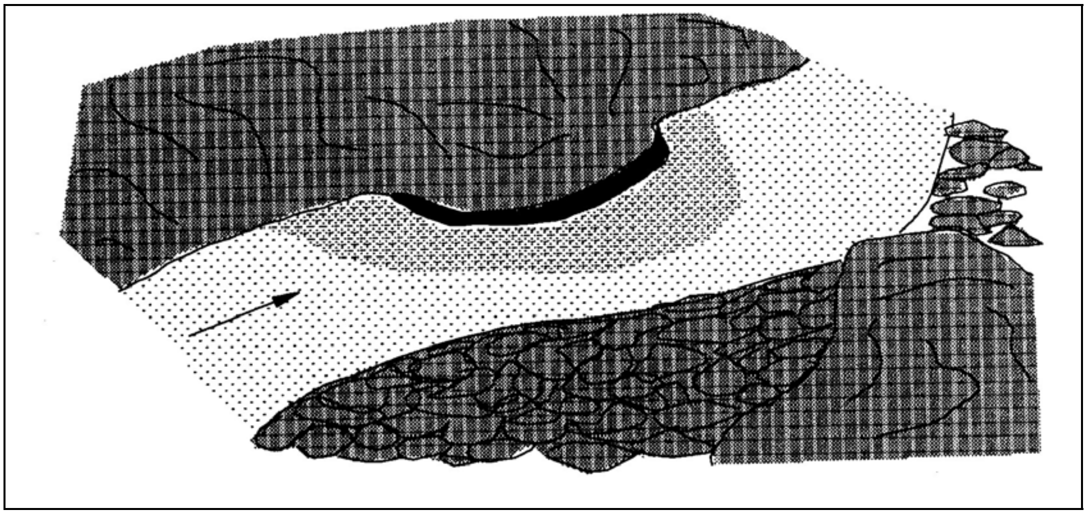
Formed by flow impinging against a partial channel obstruction consisting of large woody debris. The associated scour is generally confined to < 60% of the wetted channel width.

LATERAL SCOUR POOL - ROOT WAD ENHANCED (LSR) [5.3] {11}



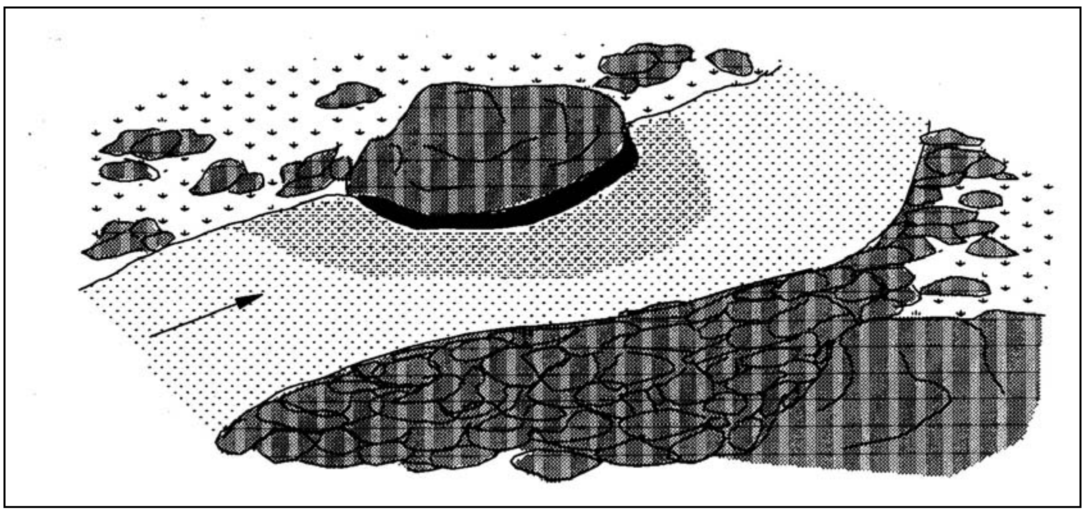
Formed by flow impinging against a partial channel obstruction consisting of a root wad. The associated scour is generally confined to < 60% of the wetted channel width.

LATERAL SCOUR POOL - BEDROCK FORMED (LSBk) [5.4] {12}



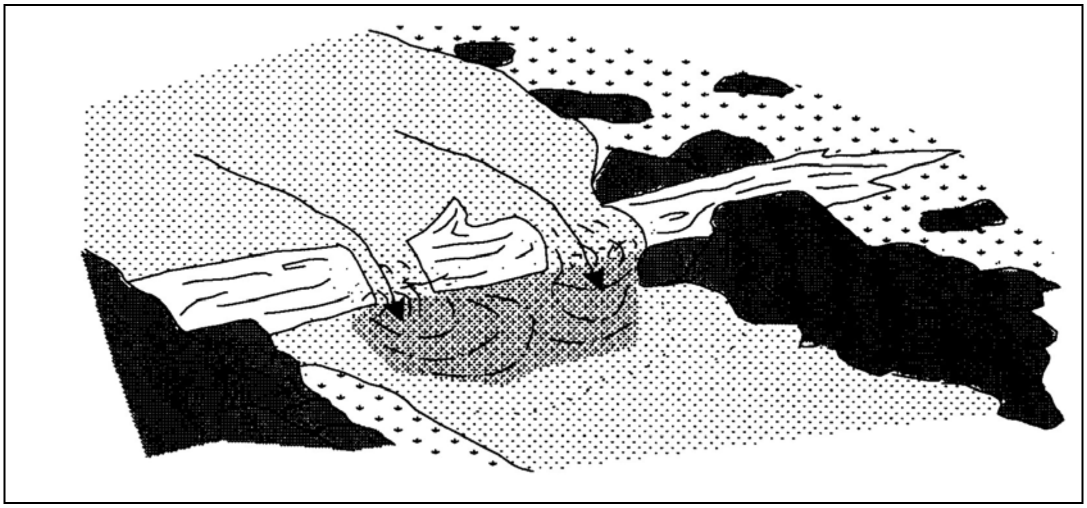
Formed by flow impinging against a bedrock stream bank. The associated scour is generally confined to < 60% of the wetted channel width.

LATERAL SCOUR POOL - BOULDER FORMED (LSBo) [5.5] {20}



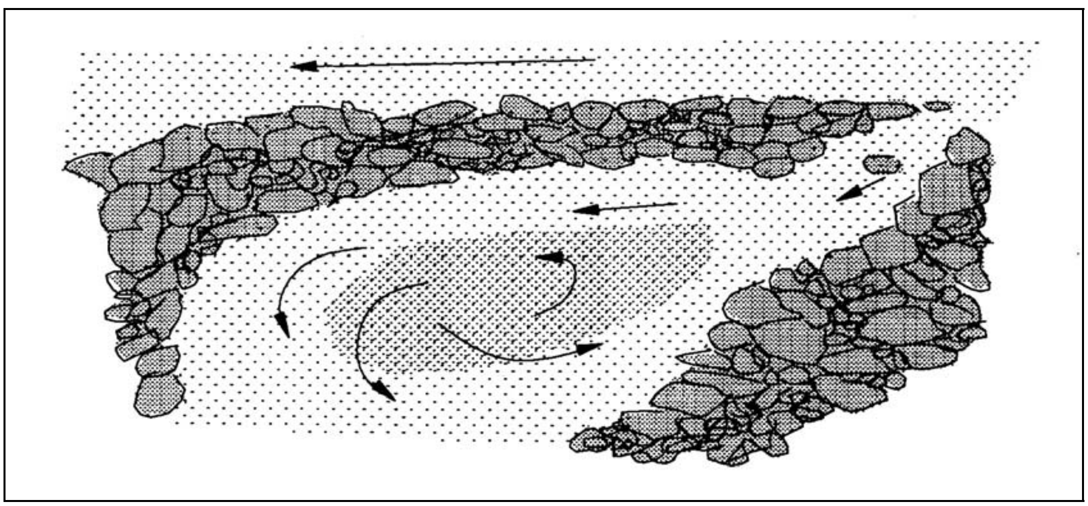
Formed by flow impinging against a partial channel obstruction consisting of a boulder. The associated scour is generally confined to < 60% of the wetted channel width.

PLUNGE POOL (PLP) [5.6] {9}



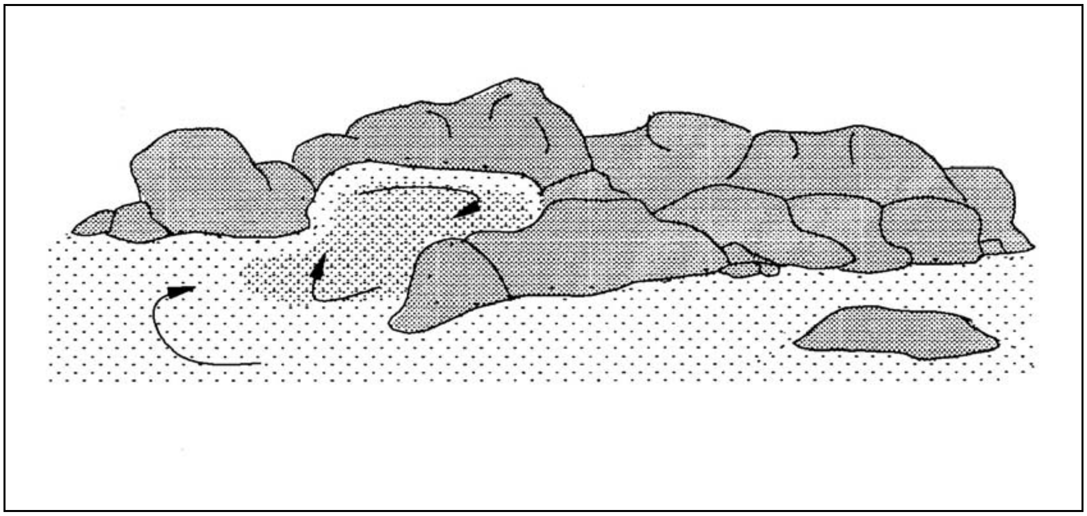
Found where the stream passes over a complete or nearly complete channel obstruction and drops steeply into the streambed below, scouring out a depression; often large and deep. Substrate size is highly variable.

SECONDARY CHANNEL POOL (SCP) [6.1] {4}



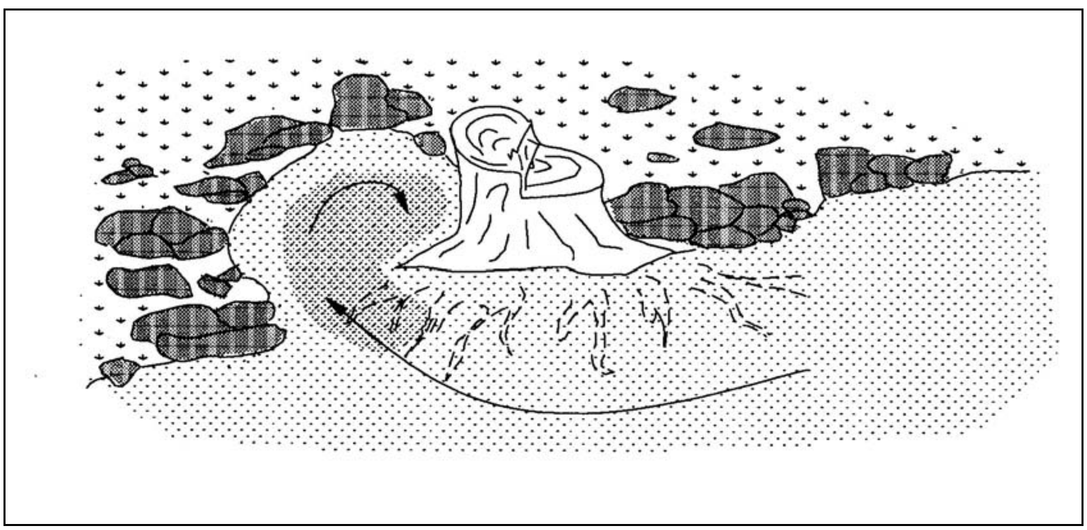
Pools formed outside of the average wetted channel width. During summer, these pools will dry up or have very little flow. Mainly associated with gravel bars and may contain sand and silt substrate.

BACKWATER POOL - BOULDER FORMED (BPB) [6.2] {5}



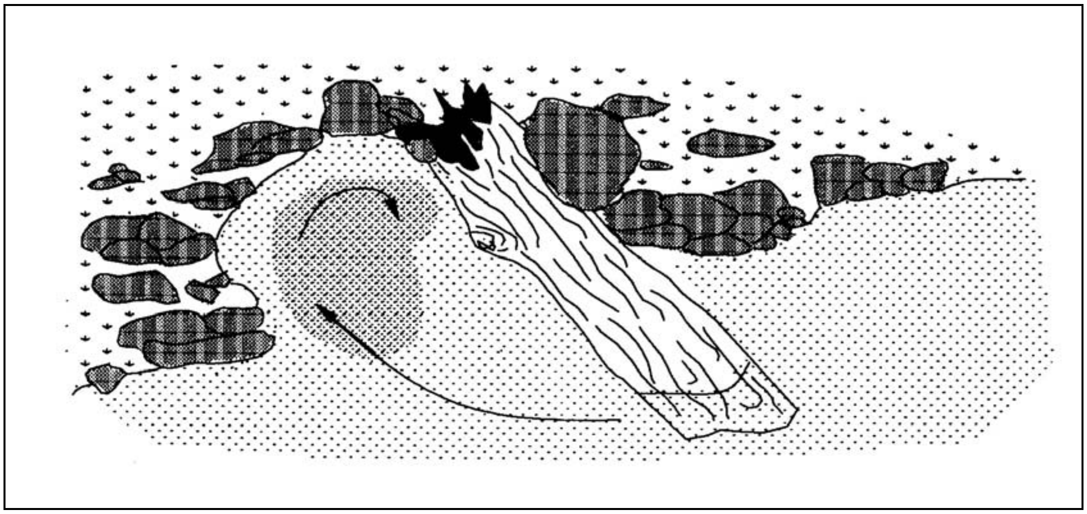
Found along channel margins and caused by eddies around a boulder obstruction. These pools are usually shallow and are dominated by fine-grain substrate. Current velocities are quite low.

BACKWATER POOL - ROOT WAD FORMED (BPR) [6.3] {6}



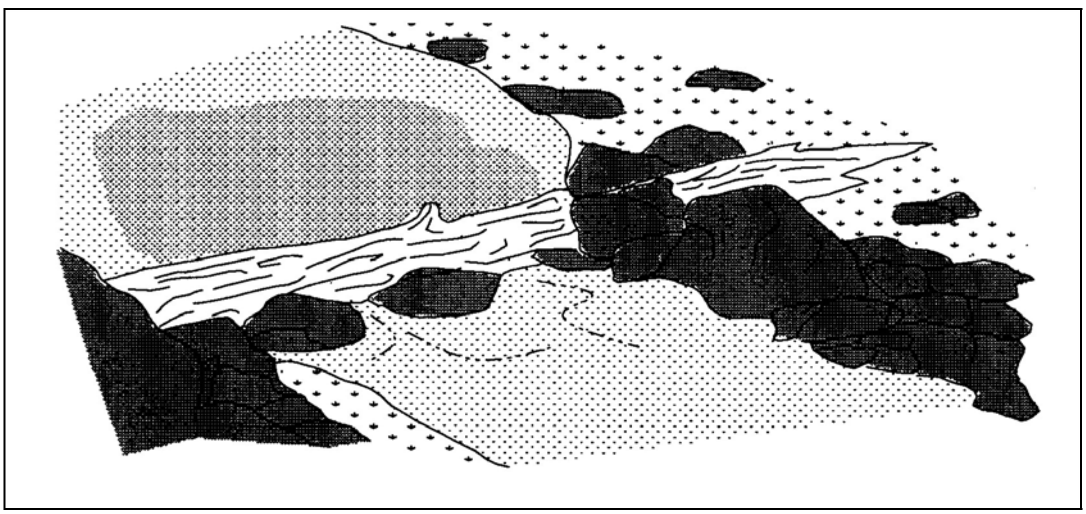
Found along channel margins and caused by eddies around a root wad obstruction. These pools are usually shallow and are dominated by fine-grained substrate. Current velocities are quite low.

BACKWATER POOL - LOG FORMED (BPL) [6.4] {7}



Found along channel margins and caused by eddies around a large woody debris obstruction. These pools are usually shallow and are dominated by fine-grained substrate. Current velocities are quite low.

DAMMED POOLS (DPL) [6.5] {13}



Water impounded from a complete or nearly complete channel blockage (log debris jams, rock landslides or beaver dams). Substrate tends to be dominated by smaller gravel and sand.

Instream Shelter

Instream shelter within each habitat unit can be rated according to a standard system. This rating system is a field procedure for habitat inventories which utilizes objective field measurements. It is intended to rate, for each habitat unit, complexity of shelter that serves as instream habitat or that creates areas of diverse velocities which are focal points for salmonids. In this rating system, instream shelter is composed of those elements within a stream channel that provide protection from predation for salmonids, areas of reduced water velocities in which fish can rest and conserve energy, and separation between territorial units to reduce density related competition. This rating does not consider factors related to changes in discharge, such as water depth.

Instream Shelter Complexity. A value rating can be assigned to instream shelter complexity. This rating is a relative measure of the quantity and composition of the instream shelter.

Value	Instream Shelter Complexity Value Examples:
0	● No shelter.
1	● One to five boulders. ● Bare undercut bank or bedrock ledge. ● Single piece of large wood (>12" diameter and 6' long) defined as large woody debris (LWD).
2	● One or two pieces of LWD associated with any amount of small wood (<12" diameter) defined as small woody debris (SWD). ● Six or more boulders per 50 feet. ● Stable undercut bank with root mass, and less than 12" undercut. ● A single root wad lacking complexity. ● Branches in or near the water. ● Limited submersed vegetative fish cover. ● Bubble curtain.
3	Combinations of (must have at least two cover types): ● LWD/boulders/root wads. ● Three or more pieces of LWD combined with SWD. ● Three or more boulders combined with LWD/SWD. ● Bubble curtain combined with LWD or boulders. ● Stable undercut bank with greater than 12" undercut, associated with root mass or LWD. ● Extensive submersed vegetative fish cover.

Instream Shelter Percent Covered. Instream shelter percent covered is a measure of the area of a habitat unit occupied by instream shelter. The area is estimated from an overhead view.

Instructions for Completing the Habitat Inventory Data Form

1) **Form No.** - Print in the form number. Number the forms sequentially beginning with "01" on the first page and "02" on the second and so on.

2) **Date** - Enter the day's date: mm/dd/yy.

3) **Stream Name** -Enter the stream name identified on the 7.5 minute USGS quadrangle. Unnamed streams should be entered as unnamed tributary to name of receiving stream.

4) **Legal** - Enter the township, range and section of the stream confluence or from where the survey started identified on the 7.5 minute USGS quadrangle.

5) **Surveyors** - Enter the names of the surveyors with the note taker listed first.

6) **Lat** - Enter the latitude taken from the 7.5-minute USGS quadrangle at the confluence of the stream (Part II- Instructions for Completing Watershed Overview Work Sheet).

7) **Long** - Enter the longitude taken from the 7.5-minute USGS quadrangle at the confluence of the stream (Part II- Instructions for Completing Watershed Overview Work Sheet).

8) **Quad** - Enter the name of the 7.5-minute USGS quadrangle on which the confluence of the stream appears.

9) **Channel Type** - Record the channel type determined from completing the Stream Channel Type Work Sheet (Part III). Record in the comments the habitat unit number in which the channel type change occurs in.

10) **Reach** - Enter the reach number beginning with 1 for the lowermost channel type in the basin. Each stream channel type change proceeding upstream will be designated by a new stream reach number.

11) **BFW** – Measure and enter the stream width at bankfull discharge elevation in the first appropriate velocity crossover on each new data sheet. Use the methods described in the Stream Channel Type Worksheet (Part III).

12) **@HU#** - Record the habitat unit number at which the bankfull width was measured.

13) **Time** - At the beginning of each page enter the time in military time (24-hour clock).

14) **Water Temperature** - At the beginning of each page record the water temperature to the nearest degree Fahrenheit. Take water temperatures in the middle of the habitat unit, in flowing water.

15) **Air Temperature** - At the beginning of each page record the air temperature to the nearest degree Fahrenheit. Take air temperatures in the middle of the habitat unit, within one foot of the water surface.

16) **Flow Measurement** - Record the flow at the beginning and the end of the survey, at the same location. Record in cubic feet/second.

17) **Page Length** - Sum the mean lengths for the page.

18) **Total Length** - Sum all the page lengths through the current page.

19) **Habitat Unit Number** - Enter the habitat unit number. Record these numbers in sequential order, beginning with "0001" at the survey start. When numbering side channels begin with the number of the unit where the split or divide begins; use a new column and entirely fill it out for each subsequent side channel unit, and number the units sequentially adding a ".1", ".2", etc. as appropriate to describe the exact position of the side channel units. Example of a side channel with two habitat units:

Habitat Unit Number	0005	0006	0006.1	0006.2	0007
Habitat Unit Type	5.3	1.1			4.2
Side Channel Type			1.1	3.2	

20) **Habitat Unit Type** - Determine the type of habitat unit and enter the appropriate habitat type number code. If the unit is dry, use 7.0 for the habitat unit type. If a stream length is contained within a culvert, use 8.0 for the habitat unit type. If the length of stream was not surveyed due to lack of access, use 9.0 for the habitat type. If the length of stream was not surveyed due to a marsh, use 9.1 for the habitat unit type. Record all pertinent information in the comments.

21) **Side Channel Type** - Determine the type of habitat unit and enter the appropriate habitat type number code.

22) **Mean Length** - Enter the thalweg length of the habitat unit, in feet.

23) **Mean Width** - Measure two or more wetted channel widths within the habitat unit. Calculate and enter the mean width for the habitat unit, in feet.

24) **Mean Depth** - Take several random depth measurements across the unit with a stadia rod. Calculate and enter the mean depth, in feet.

25) **Maximum Depth** - Enter the measured maximum depth for each habitat unit, in feet.

26) **Depth Pool Tail Crest** - Measure the maximum thalweg depth at the pool tail crest, in feet. This measurement is taken only in pool habitat units and is used to determine the pool's residual volume.

27) **Pool Tail Embeddedness** - Percent cobble embeddedness is determined at pool tail-outs where spawning is likely to occur. Sample at least five small cobbles (2.5" to 5.0") in diameter and estimate the amount of the stone buried in the sediment. This is done by

removing the cobble from the streambed and observing the line between the "shiny" buried portion and the duller exposed portion. Estimate the percent of the lower shiny portion using the corresponding number for the 25% ranges. Average the samples for a mean cobble embeddedness rating. Additionally, a value of 5 is assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate particle size, having a bedrock tail-out, or other considerations:

1 = 0 to 25%
2 = 26 to 50%
3 = 51 to 75%
4 = 76 to 100%
5 = unsuitable for spawning

28) **Pool Tail Substrate** - Enter the letter code (A through G) for the dominant substrate composition of the tail-out for all pools.

29) **Large Woody Debris Count Diameter >1' and Length from 6'to 20'** – Record the number of pieces of large woody debris that have a diameter greater than one foot and a length between six and twenty feet, and are wholly or partially within the bankfull discharge elevation of that habitat unit.

30) **Large Woody Debris Count Diameter >1' and Length>20'** – Record the number of pieces of large woody debris that have a diameter greater than one foot and a length greater than twenty feet, and are located wholly or partially within the bankfull discharge elevation of that habitat unit.

31) **Shelter Value** - Enter the number code (0 to 3) that corresponds to the dominant structural shelter type that exists in the unit (Part III- Instream Shelter Complexity).

32) **Percent Unit Covered** - Enter the percentage of the unit occupied by the structural shelter. Classify 100 percent of the shelter by the types indicated on the form. Note: bubble curtain includes white water.

33) **Substrate Composition** - Enter a "1" for the dominant substrate and a "2" for the co-dominant substrate. Note: changes in the dominant and co-dominant substrate may indicate that the channel type has changed.

34) **Percent Exposed Substrate** - Enter the estimated percentage of the bottom substrate of the unit that is exposed above the water surface.

35) **Percent Total Canopy** - Enter the percentage of the stream area that is influenced by the tree canopy. The canopy is measured using a spherical densiometer at the upstream end of each habitat unit in the center of the wetted channel. (Appendix M).

36) **Percent Hardwood Trees** - Estimate the percent of the total canopy consisting of hardwood, or broadleafed, trees. For watershed where the entire canopy consists of hardwood trees, use this field to distinguish deciduous trees, or trees that provide partial year shade and leaf-drop.

37) **Percent Coniferous Trees -** Estimate the percent of the total canopy consisting of coniferous, or needle leafed, trees. For watersheds where the entire canopy consists of hardwood trees, use this field to distinguish evergreen trees, or trees that provide year-round shade.

38) **Right Bank Composition** - Observed from the base of the stream bank to the bankfull discharge level. Enter the number (1 through 4) for the right bank composition type corresponding to the list located on the lower left hand side of the form. Enter one number only. The right bank is the right side of the stream when facing downstream.

39) **Right Bank Dominant Vegetation** - Enter the number (5 through 9) for the right bank dominant vegetation type, from bankfull to 20 feet upslope, corresponding to the list located on the lower left hand side of the form. Enter one number only.

40) **Percent Right Bank Vegetated** - Estimate the total percentage of the right bank covered with vegetation from bankfull discharge level to 20 feet upslope.

41) **Left Bank Composition** - Observed from the lower bank to the bankfull discharge level. Enter the number (1 through 4) for the left bank composition type corresponding to the list located on the lower left hand side of the form. Enter one number only. The left bank is the left side of the stream when facing downstream.

42) **Left Bank Dominant Vegetation** - Enter the number (5 through 9) for the left bank dominant composition type, from bankfull to 20 feet upslope, corresponding to the list located on the lower left hand side of the form. Enter one number only.

43) **Percent Left Bank Vegetated -** Estimate the total percentage of the left bank covered with vegetation from bankfull discharge level to 20 feet upslope.

44) **Comments -** Add comments which characterize important habitat unit observations. There are ten comment categories. Comments are begun with an initial letter code which identifies its assigned category.
   a. "S" for an instream habitat **structure** or bank stabilization project
   b. "C" for a **channel** type change
   c. "D" to document a water **diversion**
   d. "T" to record a **tributary**
   e. "E" for bank **erosion** or a landslide observation
   f. "B" to document a **biological** observation or sampling site
   g. "P" for a fish **passage** problem
   h. "A" to record a stream **access** point
   i. "G" for a location recorded with a **GPS** receiver
   j. "O" for all **other** comments that do not fall into an above category.

45) The back of the data sheet has an additional area for comments that will not fit on the front, and an area for diagrams to describe a comment.

HABITAT INVENTORY DATA FORM

Form #______ of ______

Date / /	Stream Name:		T: R: S:
Surveyors:		Lat:	Long:
Quad:	Channel Type:	Reach:	BFW: @HU#:
Time: H_2O F°:	Air F°: Flow:	Pg Length:	Total Length:

Habitat Unit Number											
Habitat Unit Type											
Side Channel Type											
Mean Length											
Mean Width											
Mean Depth											
Maximum Depth											
Depth Pool Tail Crest											
Pool Tail Embeddedness											
Pool Tail Substrate											
LWD Count D>1&L6to20											
LWD Count D>1&L>20											
Shelter Rating	Shelter Value										
	% Unit Covered										
	% undercut bank										
	% swd (d<12")										
	% lwd (d>12")										
	% root mass										
	% terr. vegetation										
	% aqua. vegetation										
	% bubble curtain										
	% boulders										
	% bedrock ledges										
Substrate Composition 2 Most Dominant	A) Silt/Clay										
	B) Sand										
	C) Gravel (0.08-2.5")										
	D) Sm Cobble										
	E) Lg Cobble (5-10")										
	F) Boulder (>10")										
	G) Bedrock										
Percent Exposed Substrate											
Percent Total Canopy											
% Hardwood Trees											
% Coniferous Trees											
Bank Composition & Vegetation	Rt Bk Composition										
	Rt Bk Dominant Vg										
	% Rt Bk Vegetated										
	Lft Bk Composition										
	Lft Bk Dominant Vg										
	% Lft Bk Vegetated										

Bank Composition Types 1) Bedrock 2) Boulder 3) Cobble /Gravel 4) Silt/Clay/Sand	Comments: **S**tructures **C**hannel **D**iversions **T**ribs **E**rosion **B**iota **P**assage **A**ccess **G**PS **O**ther
Vegetation Types 5) Grass 6) Brush 7) Hardwood Trees 8) Coniferous Trees 9) No Vegetation	

Hab Unit #	Comments

Diagrams

LARGE WOODY DEBRIS (LWD) STREAM AND RIPARIAN INVENTORY

Background

The importance of large woody debris (LWD) in the development of a stream's morphology and biological productivity has been well documented over the last twenty years. It strongly influences stream habitat characteristics and biotic composition. Bilby (1984) and Rainville et al. (1985) found that in nearly 80 percent of the pools surveyed in small streams, LWD was the structural agent forming the pool or associated with the pool. The influence that LWD has on the diversity of juvenile salmonid populations, with particular emphasis on the impact of timber harvest activities on that diversity, has been documented by Reeves et al. (1993). Fish populations are benefitted by both the cover and habitat diversity created by LWD and by the substrate environment for benthic invertebrates that serve as food (Sedell et al. 1984, Sedell et al. 1988, and Bisson et al. 1987).

Relatively large pieces of woody debris in streams influence the physical form of the channel, movement of sediment, retention of gravel, and composition of the biological community (Bilby and Ward, 1989). The relationship between size of individual LWD and its effects on channel morphology are influenced by a number of variables such as stream-flow energy, sinuosity, bank composition, and channel width. Bilby and Ward (1989) and Likens and Bilby (1982) describe LWD and its relationship to pool formation, gravel retention, channel orientation, and channel width. Once LWD enters the stream, their orientation and spacing may be more significant than their volume in influencing channel morphology and aquatic habitats (Platts et al. 1987).

LWD in this methodology is defined as a piece of wood having a minimum diameter of twelve inches and a minimum length of six feet. Root wads must meet the minimum diameter criteria at the base of the trunk but need not be at least six feet long. Four diameter ranges and two length ranges were selected to categorize LWD sizes in this inventory method:

Diameter Category		Length Category	
1.	1 - 2 feet	1.	6 to 20 feet
2.	2 - 3 feet	2.	over 20 feet
3.	3 - 4 feet		
4.	> 4 feet		

Each size category is further divided into four type categories according to condition or status of the LWD as follows:

1. Dead and down (D/D)
2. Dead and standing (D/S)
3. Perched (on the bank and soon to be in the stream channel area)
4. Live:
   a. coniferous; b. deciduous

The range of coverage of this LWD inventory includes two distinct zones: 1) the "instream zone," defined as the stream channel within bankfull discharge demarcations; and 2) the "recruitment zone," defined as that area beyond the instream zone encompassing the floodplain and an additional 50-foot wide strip measured uphill, along the slope from the outer edge of the floodplain. The recruitment zone, as defined for this LWD survey, represents about 70 percent of the LWD recruitment potential to the stream (McDade, et al., 1990; and Forest Ecosystem Management, 1993).

According to McDade et al. (1990), more than 70 percent of woody debris originates within 20 meters of the channel. He looked at the LWD recruitability of riparian vegetation as a function of distance from the stream. His study revealed that over 83 percent of the deciduous LWD and 53 percent of coniferous LWD originates within 10 meters of the stream channel. All hardwood LWD was delivered from within 25 meters, and only 13 percent of the conifers had a source distance greater than 25 meters. Also of interest, there was no significant difference ($P>0.05$) between source distance on steep and gentle side slopes, nor between source distance and stream order.

Andrus et al. (1993) studied recruitment rates based on modeling results of different riparian protection zones and stream sizes over time periods of up to 200 years to simulate long-term recruitment potential for LWD. There was a significantly greater percentage of pieces that should move toward the stream on steep slopes than on gentle slopes. For this reason we defined a "perched" condition category to describe pieces positioned for "imminent" delivery to the stream via near-stream landslides and stream bank failures common to the North Coast of California and generally along unstable or active stream channels.

LWD INVENTORY METHODOLOGY

The inventory includes equipment preparation, stream selection, access permission, stream channel typing, surveyor training, and the actual survey inventory.

Equipment list:

- Clinometer
- 7.5-minute USGS quadrangles of the stream
- Hip chain and refills
- Diameter tape, 50 feet
- LWD Inventory Forms and Stream Channel Type Work Sheets (Part III)
- Waders or hip boots
- Clipboard
- Optional:
  - 100-foot optical distance finder
  - Tree fork
  - *Timber Cruising Fieldbook* (Dilworth, 1981)

Stream selection

This methodology is best suited to first through third-order streams. If streams selected for LWD inventory have been previously stream channel typed, determine the limits and lengths of individual stream channel-type reaches to define LWD inventory reaches.

Training

Persons conducting the inventory must be familiar with stream channel typing methods, proper use of equipment listed above and recording forms presented below. Training in the field should include the following inventory procedure and daily sight calibration by each surveyor of LWD and live tree diameters and lengths.

At the beginning of each day, prior to categorizing and recording LWD, field personnel should select several pieces of LWD for sight calibration. Diameter ranges should be estimated and then verified by measuring with a diameter tape. Also, calibrate sight estimates of 6, 20, and 50 feet with length measurement verifications. Standing tree diameter is determined at breast height (54") above the ground measured from the upslope side of the tree. Diameter of downed logs is the largest diameter anywhere along the log.

Inventory Procedure

In general, the inventory is conducted by two people while walking in the stream channel, proceeding upstream. The LWD Inventory Form is designed so the stream bank entry columns must be oriented to the corresponding stream bank while facing upstream. Right and left banks are defined by convention as one looks downstream. When facing upstream the "right bank" is on the individual's left. One surveyor observes LWD, estimates sizes, and tallies LWD on one bank and LWD within the stream channel, while the other observer tallies the opposite bank. The second person can also estimate instream LWD if surveyor comparison is desired.

Recommended LWD inventory protocol requires that the stream first be stratified into reaches by stream channel types using Rosgen's methodology (Part III). Stream channel types may be determined from previous survey data, or surveyed prior to the LWD inventory. Be sure to attach copies of stream channel typing work sheets to the corresponding LWD Inventory Forms. Stream channel classification measurements within an area that is typical of the stream channel type must be determined. Avoid channel typing measurements near mouths of streams, within stream channel type transition areas, and near artificial or unusual features (e.g., bridges, slides, revetments).

Stream channel typing is important to determine start and stop distances of each stream channel type reach in order to calculate total length of each inventory reach. Begin numbering reaches with "1" as the reach nearest the stream mouth. As different stream channel types are encountered, number corresponding inventory reaches consecutively as the inventory proceeds upstream.

To begin the inventory, consider the stream segmented into 200-foot sections. Number the first six sections consecutively beginning with No. 1 as the downstream most 200-foot section. Next, toss a die to randomly select one of the first six 200-foot segments as Sample Area 1. This segment will become the first LWD inventory sample section in the stream. One LWD Inventory Form is required for each 200-foot sample section. After conducting the survey in this initial sample segment, proceed upstream 800 feet from the upper end of Sample Area 1 and inventory the next 200 feet as Sample Area 2. Sample Area 3 begins 800 feet upstream from the upper end of Sample Area 2, and so on. Stated another way, with the stream segmented into 200-foot sections, this procedure involves using a random start within the first six sections and then systematically sampling every fifth 200-foot section. Continue the LWD inventory in this manner until the stream channel type changes. Be certain to note on the LWD Inventory Forms the distance measurements of where channel types change and a new inventory reach begins. When a new reach begins, the pattern of sampling every fifth 200-feet section can proceed uninterrupted (i.e., it is not necessary to repeat the random start procedure at each stream channel type change).

Beginning at the downstream end of the first 200-foot section, Sample Area 1, observe and tally, in the appropriate boxes on the LWD Inventory Form, all LWD pieces or live trees within the sample area with diameters ≥ 1 foot and lengths ∃ 6 feet, and root wads with a trunk diameter ≥ 1 foot.

During the survey in each 200-foot sample area, each of the surveyors will, periodically, ask the other to measure the diameter and length of the last estimated tree or LWD, and to measure the 50 foot estimated bank distance, and 6 and 20 foot tree length distances for accuracy and calibration purposes. Results of each measured estimate will be recorded on the calibration form. This ongoing calibration effort serves to keep the surveyors' estimates more accurate, and also provides the basis for analyzing the data for standard error.

To eliminate the problem of an insufficient number of samples that would represent LWD conditions in short streams or reaches, it is recommended that stream reaches less than 1,000 feet in length be surveyed throughout their entire length.

Downed large wood which is out of sight on terrace benches, usually has little chance of entering the stream. Therefore, if a piece of LWD cannot be observed from within the stream by a surveyor, it is not tallied. Also, well-rooted tree stumps located back on high bank terraces are not tallied because they have little or no potential for recruitment to the stream.

Root wads are differentiated from stumps in not being secure in the ground. Stumps are fully rooted in the ground and are at distances far enough from the stream that there is little or no potential of them being uprooted and entering the instream zone. Root wads have a high potential for reaching the stream channel. Root wads classified as dead/down are anchored in the ground by less than 25 percent of their root system, or are already "loose" and free to be moved, or are already in the channel. Root wads classified as dead/standing are anchored in the ground by at least 25 percent of their root system and have a good likelihood of being moved from the recruitment zone (bank) to the stream channel, or may already be in the stream channel. Root wads classified as "perched" are on the bank, and their movement into the stream channel is imminent. There is no classification for "live" root wads. If a root wad is sprouting, it is classified as a live tree and categorized based on diameter of the sprouting stem.

LWD INVENTORY FORM KEY

1) **Stream** - Stream name.

2) **Sample __ of __** - Indicate Sample No. of total 200-foot sample sections surveyed for each reach. Each sampled section is numbered consecutively proceeding upstream.

3) **Reach No.** - Number reaches consecutively beginning from the stream mouth. The reach number changes when the stream channel type changes (i.e., each reach is a distinct stream channel type).

4) **Date** - Date of survey (mm/dd/yy).

5) **Drainage** - River system.

6) **USGS Quad(s)** - Name(s) of 7.5-minute USGS topographic quadrangles.

7) **Reference Point** - Stream mouth or fixed landmark (bridge, tributary).

8) **Feet from Ref. Pt.** - Start: Distance from landmark at survey start.
Stop: Distance from landmark at survey end.

9) **Total Reach** - Total length in feet of inventoried reach, includes sampled and unsampled sections. Each reach is a distinct channel type.

10) **Latitude** - Latitude of stream confluence point.

11) **Longitude** - Longitude of stream confluence point.

12) **T__R__S__** - Township, range, and section of stream confluence.

13) **Surveyors** - Names of individuals conducting the inventory.

14) **Channel Characteristics** - Attach completed Stream Channel Type Work Sheet.

15) **Discharge Q** - Discharge in cfs at time of survey.

16) **Gradient** - Water surface slope in percent.

17) **Stream Channel Type** - From Stream Channel Type Work Sheet.

18) **Percent Substrate in Boulders** - Percent of the substrate in boulders in two size classes (does not = 100%). Size classes are 1-3 feet diameter, and greater than 3 feet diameter, measured at smallest diameter.

19) **Air Temp** - Air temperature in degrees Fahrenheit.

20) **Water Temp** - Water temperature in degrees Fahrenheit.

21) **Right Bank** - The stream's right bank, facing downstream, measured from bankfull discharge demarcation [bankfull width (W_{bkf})] to a point 50 feet upslope from the edge of the floodplain.

22) **Stream** - The channel area within bankfull width (W_{bkf}).

23) **Left Bank** - The stream's left bank, facing downstream, measured from bankfull discharge (Q_{bkf}) demarcation to a point 50 feet upslope from the edge of the floodplain.

24) **Slope** - Average percent slope of the right and/or left bank within the surveyed reach.

25) **Dom. Veg.** - The dominant live vegetation less than 1 foot in diameter within the entire survey reach is recorded by type and percentage: Code: 1 = Deciduous; 2 = Coniferous. The percent of the dominant type is noted as a decimal %. For example, an observation of deciduous vegetation estimated to compose 70% of the small (<1' diameter) vegetation should be recorded as: 1.70.

26) **D/D** - Number of dead and down pieces.

27) **D/S** - Number of dead and standing stems.

28) **Per** - Number of perched pieces for imminent delivery to stream.

29) **Live** - Number of live trees in two classes, coniferous and deciduous.

30) **Size Classes** - Range in upper part of box = diameter.
Range in lower part of box = length.

Example: the first row is: 1 - 2d x 6 - 20, which indicates the diameter category of 1 - 2 feet and a length of 6 - 20 feet.

31) **Root** - Root wads are a separate size class. They must meet the minimum diameter at the base of the trunk but are not required to meet the minimum 6 feet length criteria.

32) **Comments** - Note indicators of old forest systems (i.e., large stumps). Note presence of fish restoration structures, and if they were tallied. Note suppressed trees if present. Include fish and wildlife observations. Use back side of form if needed.

L W D   I N V E N T O R Y   F O R M

Stream: ______________________________ **Sample** _____ of _____ **Reach No.** __________

Date ______/_____/_____ **Drainage:** __________________________ **USGS Quad:** __________

Reference Point: ____ **Sample Length (Ft)** ___

Reach Location (Feet From Ref.Pt) Start __________ Stop __________ Total __________

Lat ____ ____ ____ N **Long** ____ ____ ____ W (Reach start or Ref.Pt.) **T** _____ **R** _____ **S** _____

Surveyors: ____

CHANNEL CHARACTERISTICS (Attach Channel Typing Form)

Discharge Q __________ cfs Gradient ____________ % Channel Type: __________

Percent Substrate in Boulders: (1'- 3') __________%; (>3') ____________%

Air Temp _______ Water Temp __________

	Right Bank % Slope _______ Dom. Veg. _____					**Stream** Dom. Veg. _____				**Left Bank** % Slope _______ Dom. Veg. _____				
	D/D	D/S	Per	Live C	Live D	Dead/ Down	D/S	Live C	Live D	D/D	D/S	Per	Live C	Live D
1-2d 6-20														
Root														
1-2d >20'														
2-3d 6-20														
Root														
2-3d >20'														
3-4d 6-20														
Root														
3-4d >20'														
>4d 6-20														
Root														
>4d >20'														

Note any LDAs (log jams), estimate size LxWxH and no. pieces. Note if gravel is retained upstream. Tally live conifer "C" and deciduous "D" trees separately. Tally root wads by diameter of "trunk". Include root wads <6' total length.

Comments:

ESTIMATE CALIBRATION FORM

Stream Name ______________________________ **Date** ______________

Surveyors ____

Reach No. ________

	Right Bank		**Stream**				**Left Bank**	
Sample	EST DIA.	TRUE DIA.	EST DIA.	TRUE DIA.	EST LENG.	TRUE LENG.	EST DIA.	TRUE DIA.
%								
Dis								

Reach No. ________

	Right Bank		**Stream**				**Left Bank**	
Sample	EST DIA.	TRUE DIA.	EST DIA.	TRUE DIA.	EST LENG.	TRUE LENG.	EST DIA.	TRUE DIA.
%								
Dis								

Calibration Form Key

Stream Name: Enter name of stream
Date: Enter date of survey (mm/dd/yy)
Surveyors: Enter name of persons conducting the survey
Reach No.: The number that corresponds with the Reach No. on the LWD Survey Form.
Sample: The number corresponding with the Sample No. on the LWD Survey Form.
EST DIA.: Enter the estimated diameter.
TRUE DIA.: Enter the measured diameter.
EST LENG.: Enter the estimated length.
TRUE LENG.: Enter the measured length.
% Enter the average percent difference between estimate and true.
Dist.: Enter the 50-foot distance estimate and measurement.

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