NOAA Fisheries Fish Passage Guidance and Criteria

Salmonid Restoration Federation
Fish Passage Design and Engineering Field School
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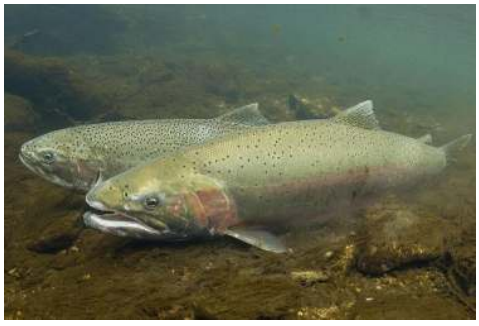
Why do we have Fish Passage Design Guidance Documents?

- Consistent standard for fish passage projects
- Allow designers to understand agency requirements from the start of the design process
- Basis of communication between project proponents and agencies

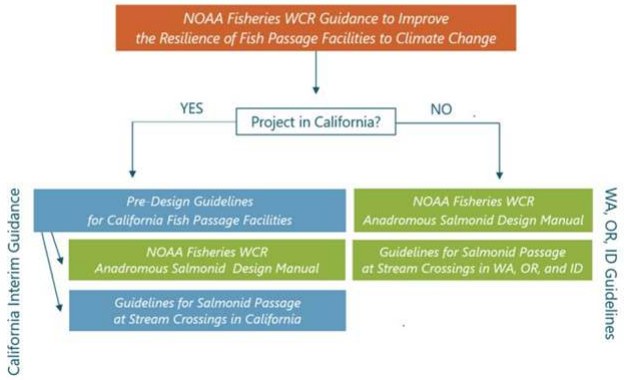


Steelhead Trout (Image: NOAA Fisheries)

Early communication is key! The guidelines provide room for site-specific recommendations.

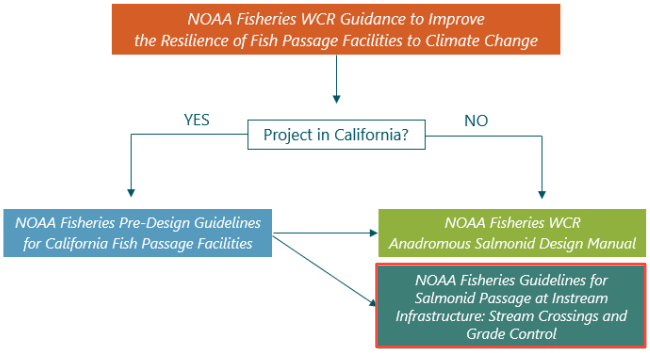
NOAA Fisheries Guidance Documents

National Oceanic and Atmospheric Administration (NOAA)
West Coast Region (WCR) Guidelines Document Flow Chart



NOAA Fisheries Guidance Documents

National Oceanic and Atmospheric Administration (NOAA)
West Coast Region (WCR) Guidelines Document Flow Chart



NOT YET RELEASED – PLANNED FOR 2025

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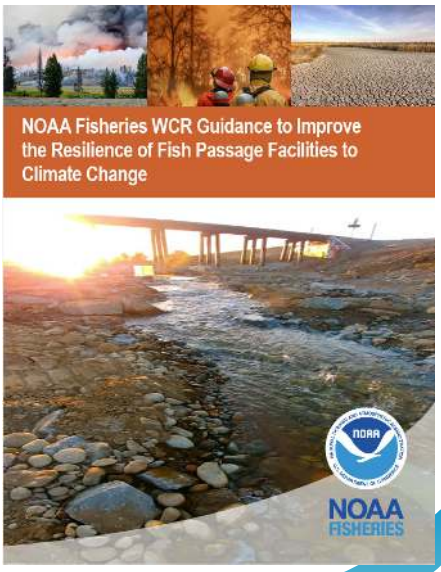
Climate Change

Provides resources to improve the resilience of fish passage facilities and approach uncertainty

- Consider climate-adjusted hydrology, resources such as:
  - Climate Toolbox
    https://climatetoolbox.org/tool/Climate-Mapper



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Pre-Design Guidelines

Currently California specific, provides information to inform design alternative selection

- Pre-design checklist (Chapter 7)
- Information on CA hydrology and variability
- Recommends 1% exceedance for CA high fish passage design flow

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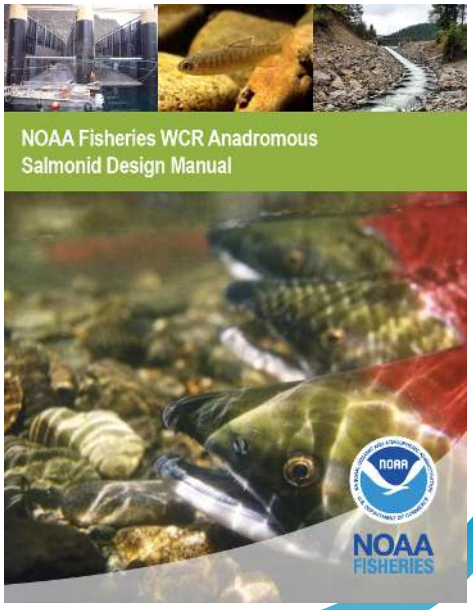
Anadromous Salmonid Design Manual (2022)

Guidance on (typically) larger projects:

- Upstream Adult Passage Systems
  - Technical ladders
- Fish Screens
- Exclusion Barriers
  - Picket weirs, drop structures
- Fish Trapping

This document supersedes:
Northwest Region's Anadromous Salmonid Passage Facility Design (2011);
Southwest Region's Fish Screening Criteria for Anadromous Salmonids (1997);
Southwest Region's Experimental Fish Guidance Position Statement (1994);
Southwest Region's Water Drafting Specifications (2001)



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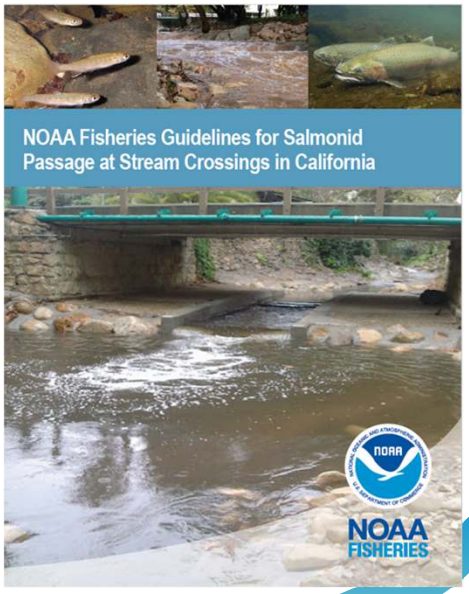
California Stream Crossing Guidelines

Combining Stream Crossing Guidance for entire WCR

Update expected Fall 2025



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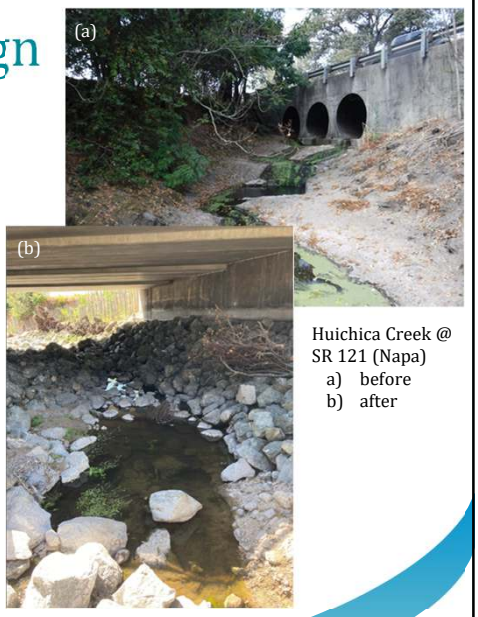
Preferred Stream Crossing Design

1. **Nothing** - Road realignment to avoid crossing the stream
2. **Bridge** - span the stream corridor for long term dynamic channel stability
3. **Stream Simulation** - mimics characteristics of the natural channel
4. **Hydraulic Design** - target depth, velocity, jump height, for specific species
   - Baffled culverts, technical fish ladders, roughened channels, nature-like fishways. Often used for retrofits.



Huichica Creek @ SR 121 (Napa)
a) before
b) after

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Stream Simulation

Stream Simulation design simulates natural stream geometry, and maintains continuity of stream processes through the crossing.

Fish Passage window should have the same timing, frequency, and duration as the natural channel.

If design criteria are met, no hydraulic modeling is required.

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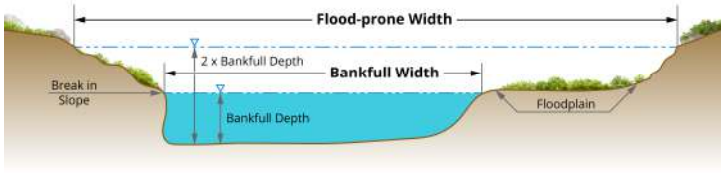
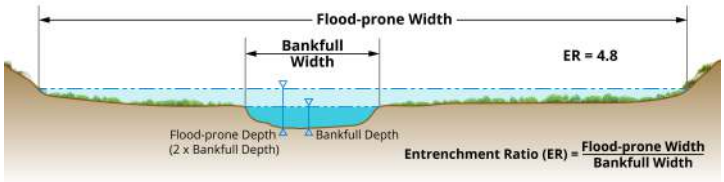
Where is Stream Simulation best applied?





Moderately entrenched to entrenched channels

Additional considerations needed for:

- Expansive floodplains
- Alluvial fans
- Coastal sites
- and others….

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Criteria: Design Span = 1.5x Bankfull width (min 6 ft)

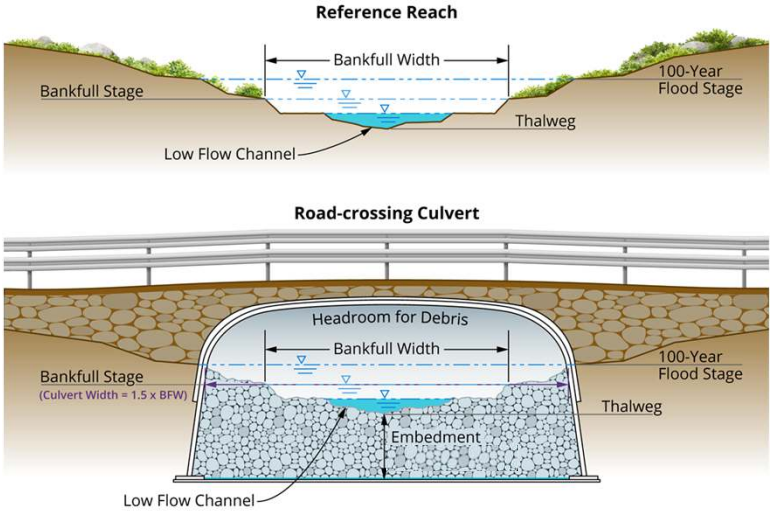


Image adapted from USFS 2008

- Select an appropriate reference reach
- Take multiple bankfull measurements (typically min of 5)
- Structure could be a culvert or bridge

Criteria: Maximum design slope = 1.25 times the average natural slope upstream/downstream

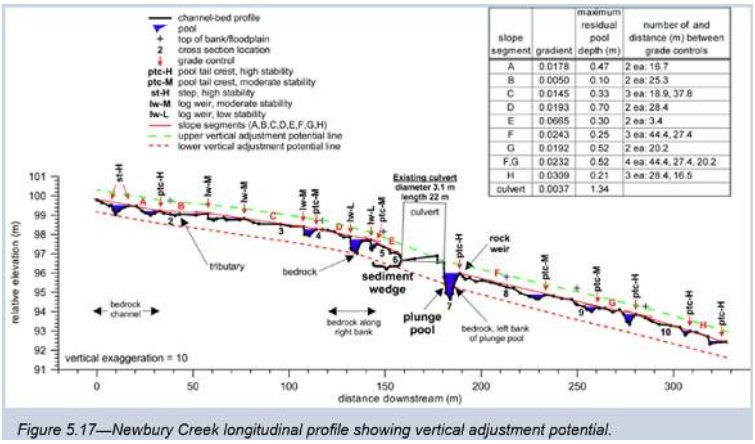
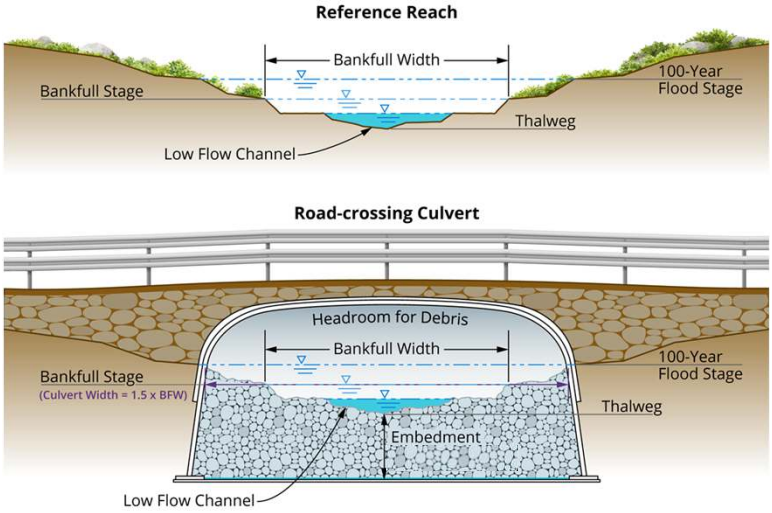


Figure 5.17—Newbury Creek longitudinal profile showing vertical adjustment potential.

Image from USFS 2008

- Collect longitudinal profile
- Aim for same slope as the reference reach
- Goal is to maintain sediment transport characteristics
- If this can't be met, Stream Simulation may not be the best design

Criteria: Minimum embedment



- Closed bottom culverts: embed 30% - **50%** of the culvert height
- Bottomless structures: footings or foundation designed for the largest anticipated scour depth
- Goal – retain sediment within crossing

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Other Best Practices for Stream Simulation

- Use native bed material when possible, or streambed material mixes which mimic the native bed
- During construction, place bed material in 1 foot lifts and seal with fines
- Use habitat features that mimic the reference reach to maintain a low flow channel through a crossing

Image from CDFW Part XII (2009), Stossel Creek culvert

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Hydraulic Design

Hydraulic Design matches the hydraulic performance of a project with the swimming abilities of a target species and age class of fish.

Less likely to provide other ecosystem benefits, or passage for non-target species.

Requires significant data analysis, including hydrologic analysis and hydraulic modeling.

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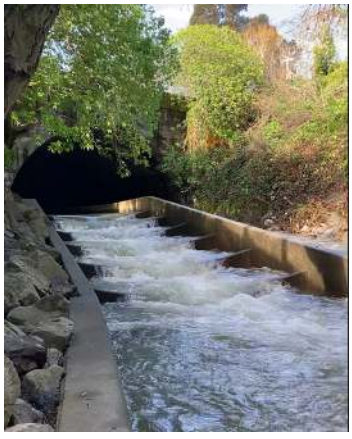
Criteria: Fish Passage Design Flow

High fish passage design flow:

- Adults - 1% exceedance flow during the migration season (where 20+ years of gauge data exist) or 50% of the 2-year event (where less than 20 years of gauge data exist)
- Juveniles - 10% annual exceedance flow

Low Fish Passage Design Flow:

- Adults - 50% annual exceedance flow or 3 cfs, whichever is greater
- Juveniles - 95% annual exceedance flow or 1 cfs, whichever is greater



San Anselmo Creek Fish Ladder, Marin, CA

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Criteria: Maximum Velocity

Maximum average cross sectional velocity for adults:

Culvert Length (ft)	Velocity (fps) - Adult Salmonids
<60	6
60-100	5
100-200	4
200-300	3
>300	2

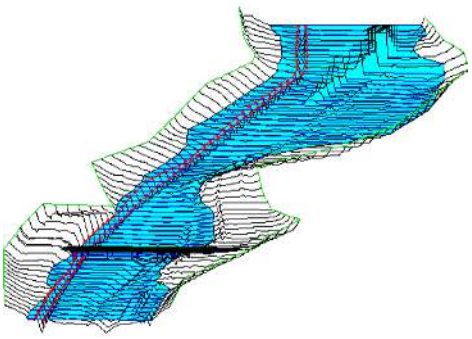


Image from HEC RAS Hydraulic Reference Manual (USACE 2020)

Juvenile upstream passage: 1 fps

In some cases, over short distances, 2 fps may be considered

Criteria: Minimum Depth

Minimum Water Depth at the Low Fish Passage Design Flow:

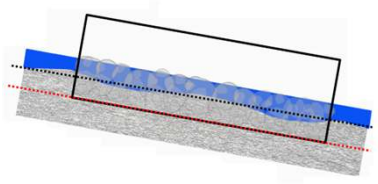
- 12 inches for adult steelhead and salmon
- 6 inches for juvenile salmon

Criteria: Hydraulic Drop

- Avoid hydraulic drops between the culvert and adjacent channel
- Where a hydraulic drop is unavoidable, it should not exceed 1 foot
  - Evaluate for both high design flow and low design flow
- If a hydraulic drop occurs at the culvert outlet, a jump pool of at least 2 feet in depth should be provided

Other Hydraulic Design Criteria

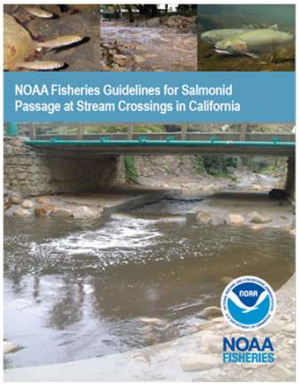
- Culvert Width – minimum of 3 feet
- Culvert Slope – not to exceed slope of stream reach
- Embedment – minimum of 20% of the height of the culvert below the elevation of the tailwater control point downstream of the culvert, not less than 1 foot
- Crossings should be designed to withstand the 100-year flood flow
- Avoid abrupt transitions in slope or flow direction



Culvert slope approximates stream slope

What has changed in the CA Guidelines since 2001?

2019 Update (Addendum 1)	2023 Update (Addendum 2)
Hydraulic design: Maximum hydraulic drop for juvenile salmonids updated from 6" to 12" **Site specific conditions may justify different criteria, i.e., the presence of very small or critically endangered fish, very cold water, or matching the gradient of the local reference reach.*	Stream simulation: Minimum crossing span is changed from equal to or greater than the bankfull channel width to **1.5 times the bankfull channel width**
Hydraulic design: high fish passage design flow for all hydraulic designs should be: - 50% of the 2-year event (where less than 20 years of gauge data exist) or - the 1% exceedance flow during the migration season (where 20+ years of gauge data exist).	Stream simulation: Slope of the reconstructed streambed within the crossing should **maintain an average slope of 1.0 to 1.25 times the natural average slope** of the adjacent upstream and downstream reaches.
	Added a cover sheet to align with the body of WCR fish passage guidance documents issued in 2022/2023



Resources

NMFS Guidance Documents are available online:

www.fisheries.noaa.gov/west-coast/habitat-conservation/west-coast-fish-passage-guidelines

Image Citations:

Part XII: Fish passage design and implementation, 2009. California Salmonid Stream Habitat Restoration Manual. California Department of Fish and Game.

U.S. Forest Service (USFS), 2008. Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road–Stream Crossings. Publication 0877-1801. San Dimas Technology and Development Center, U.S. Department of Agriculture, Forest Service, Stream Simulation Working Group. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm91_054564.pdf.


Questions?
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