Channel Restoration
San Clemente Dam Removal

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Channel Restoration
San Clemente Dam Removal

• Official Project Name:
Carmel River Reroute and San Clemente Dam Removal (CRRDR)

• Presentation Outline
  ▪ Project Overview and Goals
  ▪ Project History
  ▪ Channel Restoration Design
  ▪ Iterative Two-Dimension Modeling
  ▪ Design-Build
  ▪ Construction (in progress)
Project Overview
Project Overview

San Clemente Creek
Carmel River
West Tributary
San Clemente Dam
East Tributary
Project Overview

- Project Features
  - Dam Removal
  - Reroute and Diversion Dike
    - Carmel River to San Clemente Creek
  - Sediment Stockpile
  - Stabilized Sediment Slope and East Tributary Design
  - Channel Restoration
  - Habitat Restoration

Channel Restoration for the San Clemente Dam Removal
Project Goals

Provide river function which includes:

- Fish passage,
- Sustainability,
- Aquatic habitat, and
- Natural variability
Project History

- 106-foot-high, 300-foot-long Concrete Arch
- 24 openings (6 ft W x 12 ft H)
- Original Capacity = 1425 acre-ft

Channel Restoration for the San Clemente Dam Removal

- May 1920 – March 1922
- 7,070 CY of Concrete
- Current Capacity = 70 acre-ft
Channel Restoration Design

- Step-Pools
- Plane Bed
- Riffle Bed
- Resting Pools
- LWD and Other Floodplain Roughness Elements
- Channel Stability for 50-year return period flood

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Channel Restoration Design

• **Step Pools**
  - Step-pool sequences include 5 to 11 individual steps with drop heights of 1 foot
  - Sub-Reaches: 125 to 200 feet long
  - Individual Step-Pools: 20 to 31 feet long
  - Maximum slope of 5%

• **Resting Pools**
  - Maximum Spacing of 200 feet
  - Minimum Length of 75 feet
  - Cover habitat of 40 percent of the pool margin
  - Total Energy Dissipation Factor (EDF) of 4
    - \( EDF = \frac{gQh}{V} \)
    - Where \( g \) is the unit weight of water, \( Q \) is total discharge, \( h \) is the head drop over the step, and \( V \) is the total pool volume
Channel Restoration Design

- **Plane Bed**
  - Plane-bed Segments have lengths up to 190 feet, depth of 3 feet, bottom width of 55 feet, and a maximum slope of 2%

- **Riffle Bed and Riffle Pool**
  - Reroute Channel, approximately 780 feet long, typical depth of 3 feet, bottom width of 60 to 65 feet, and a slope of 0.75%
Iterative Two-Dimensional Modeling

- Channel Design or Redesign
- Constructability Review
- AutoCAD Civil 3D
- Meet Requirements?
- SRH-2D
- Results Review

Channel Restoration for the San Clemente Dam Removal
Iterative Two-Dimensional Modeling

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Bed profile and water-surface profiles over the range of fish passage flows

Depth patterns in a typical step-pool sequence during fish passage flows: 16 cfs

Meet Requirements?
Iterative Two-Dimensional Modeling

Channel Design or Redesign

Constructability Review

Meet Requirements?

AutoCAD Civil 3D

SRH-2D

Results Review

Energy Dissipation Factor (lb/ft)

Discharge (cfs)

Pool 1
Pool 2
Pool 3
Pool 4
Pool 5
Pool 6

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Channel Restoration for the San Clemente Dam Removal
Channel Restoration Design
Design-Build

- Design Schedule
- Short Construction Windows
  - May to October
- Site Balancing
  - Boulders
  - Earthwork
  - Large Woody Debris

Channel Restoration for the San Clemente Dam Removal
Construction

Step-Pool Construction
Construction

Large Woody Debris

Channel Restoration for the San Clemente Dam Removal
Construction

Upper Carmel River

View from East Tributary
Construction

Dam Removal
Questions?

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