Hoover Dam Bypass & Colorado River Bridge

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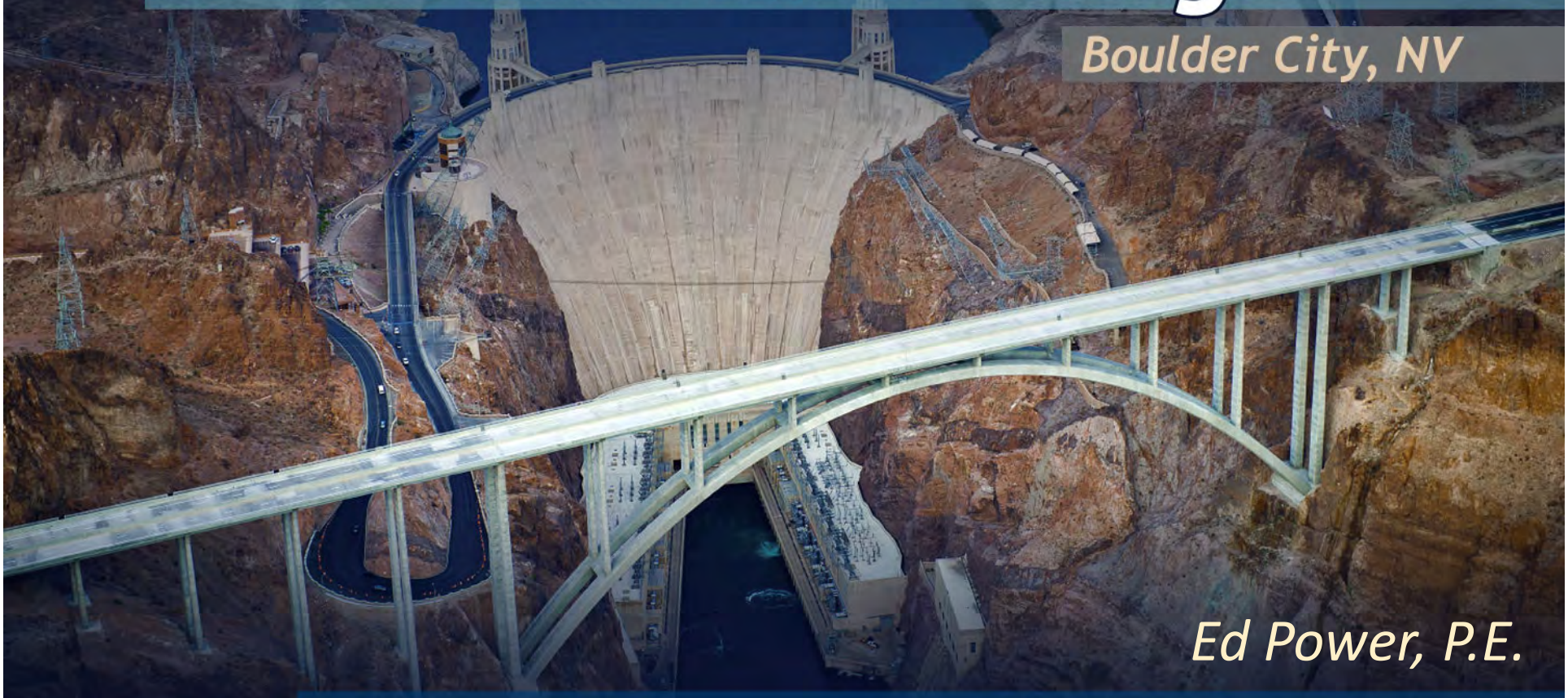

Boulder City, NV

Ed Power, P.E.

ASHE National Conference
Bismarck, ND

June 13, 2014

Hoover Dam Bypass Project

- Is the “dam thing” done yet?

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Hoover Dam Bypass Project

- The Mike O'Callaghan-Pat Tillman Memorial Bridge
- Dedicated on October 14, 2010

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Hoover Dam Bypass Project

- Project Overview
- River Bridge Design Concept
- River Bridge Construction

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PROJECT OVERVIEW

A Team Effort for a "Multi-Project"

- **Lead Agency**
  - Federal Highway Administration - Central Federal Lands Highway Division
- **Additional Stakeholders**
  - Arizona DOT, Nevada DOT, National Park Service
  - Lake Mead National Recreation Area,
  - U.S. Bureau of Reclamation, Western Area Power Administration
- **Environmental Consultant**
  - CH2MHill
- **Design Consultants – H**oover **S**upport **T**eam
  - **H**DR
  - **S**verdrup (Now Jacobs Engineering)
  - **T**.Y. Lin International
- **Geotechnical Subconsultant**
  - AMEC Earth and Environmental

A Half-Century in the Making

1960s
Identification of Project Needs

1990
Environmental Process Begins

2001
Final Environmental Impact Statement (FEIS) Released

Record of Decision Signed

2003
Construction Begins

1960 1970 1980 1990 2000 2010

1984
Hoover Power Plant Act Authorizes Project

1995-1997
Project Put on Hold

2001
Design Begins

October 2010
Dedication Ceremony

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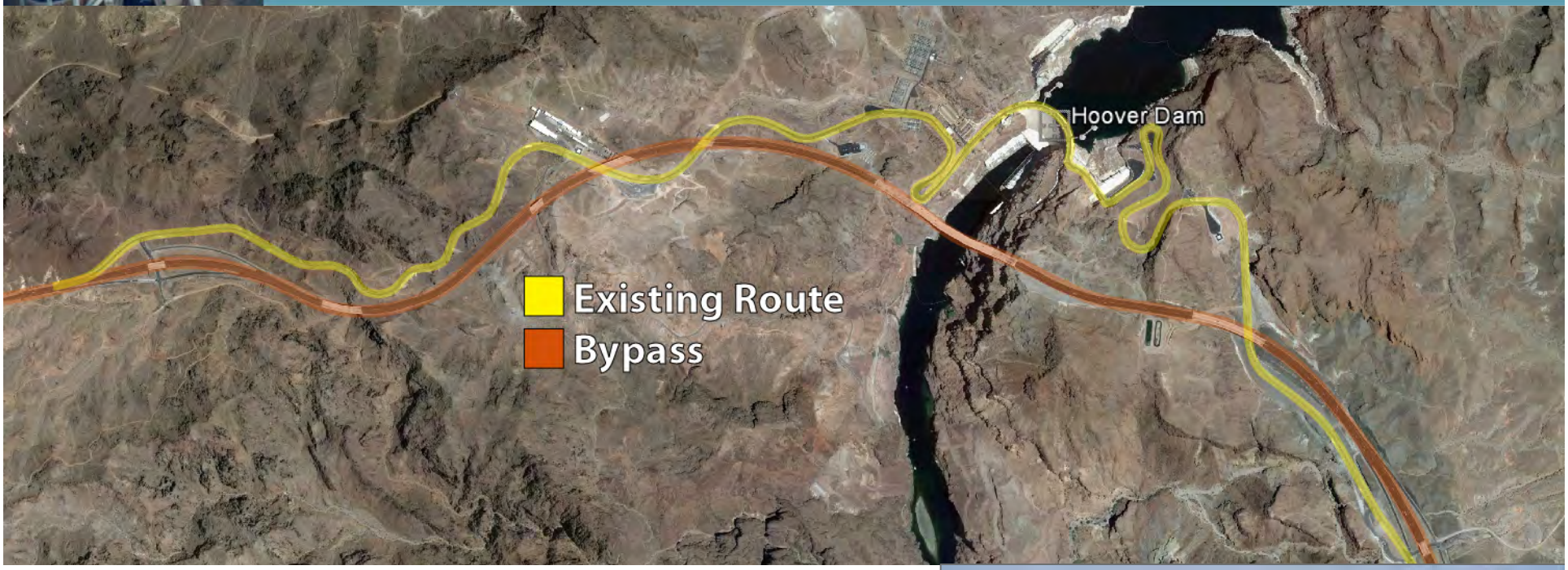
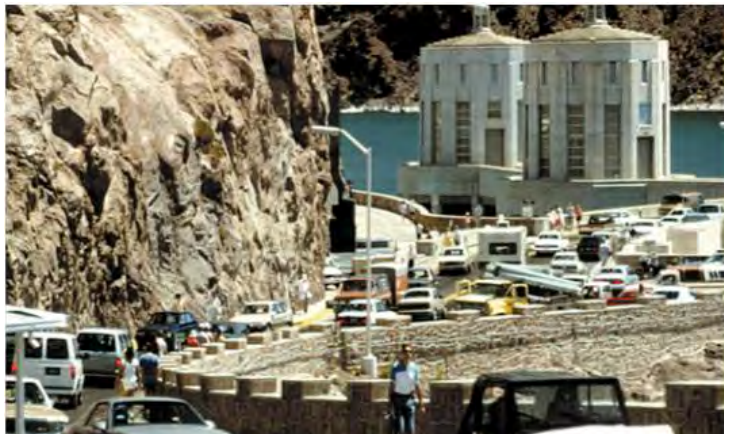
An Existing Bottleneck on U.S. 93



- Original 2-lane roadway
- Major commercial corridor
- Major tourist attraction
- Long traffic backups
- Dangerous conditions

Project Had Many Objectives

- Remove trucks and through-traffic
- Remove U.S. 93 bottleneck
- Reduce traffic accidents
- Protect Hoover Dam facilities, workers and visitors
- Protect waters of the Colorado River
- Reduce interference with dam operations
- Enhance visitor experience



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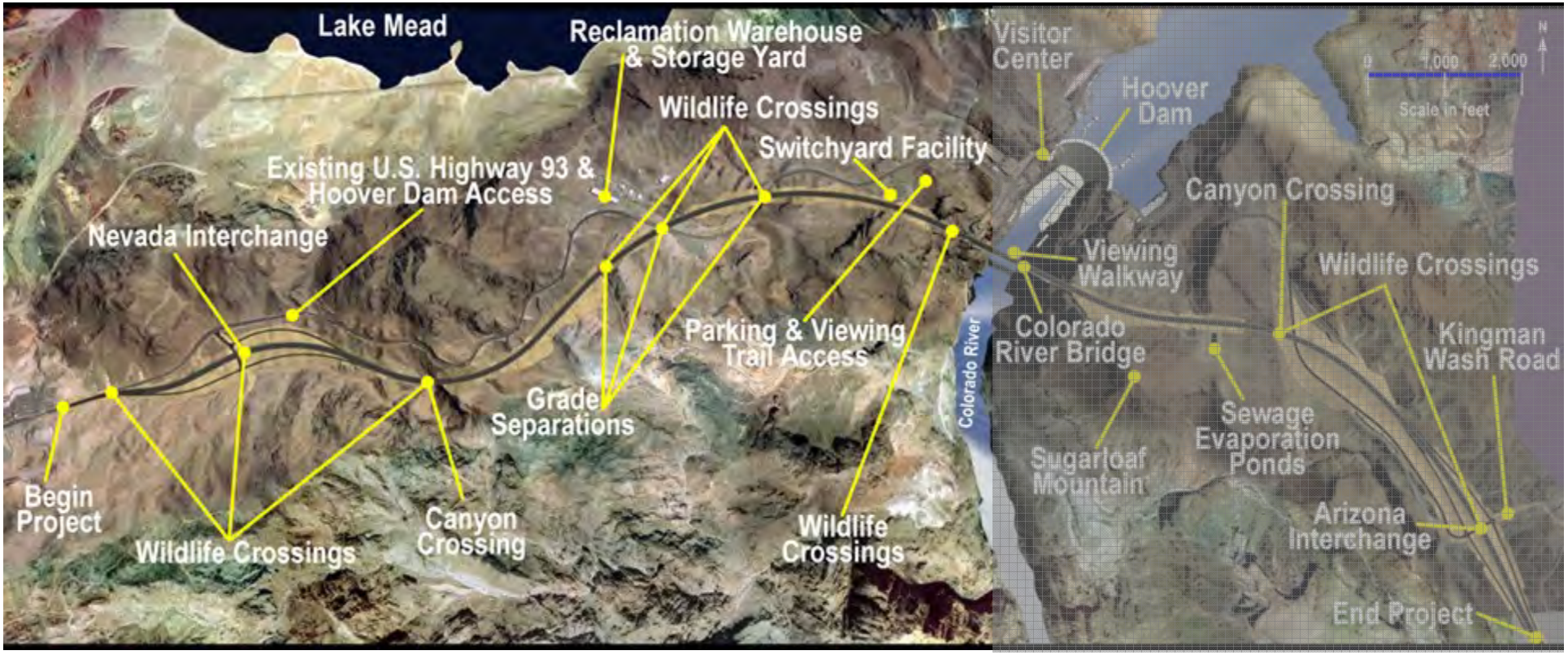
Hoover Dam Bypass – The Solution



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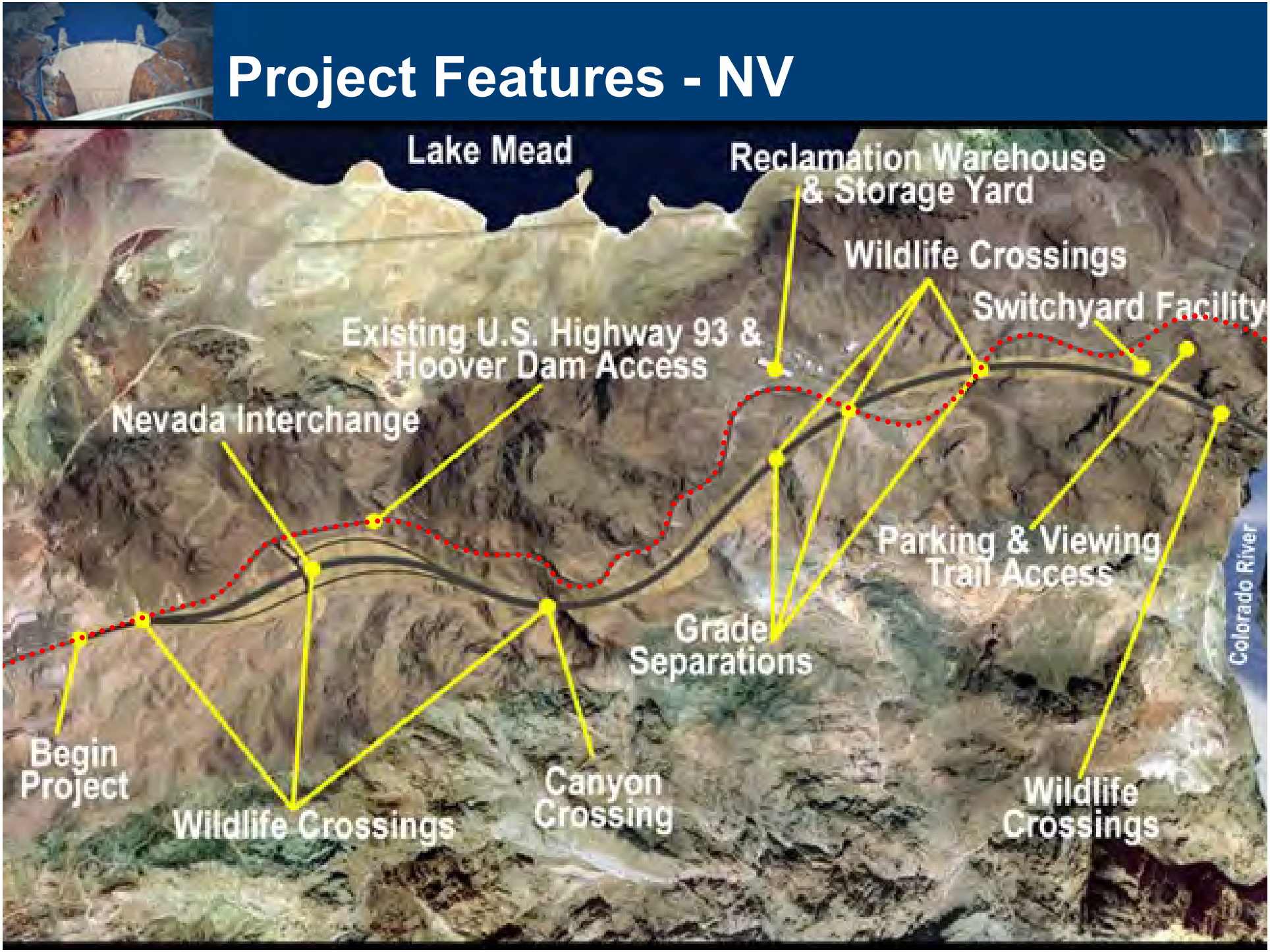
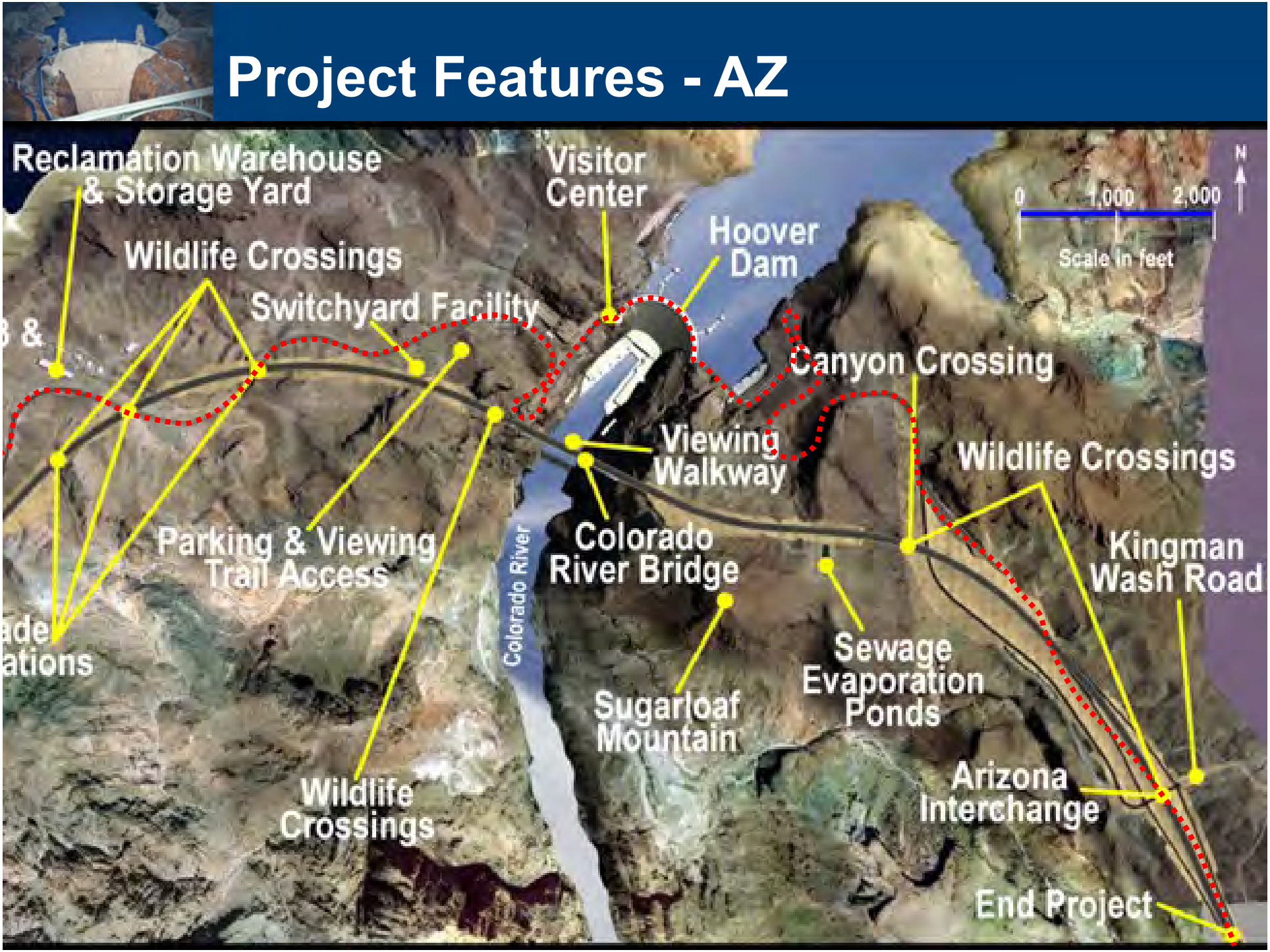
Project Features - NV

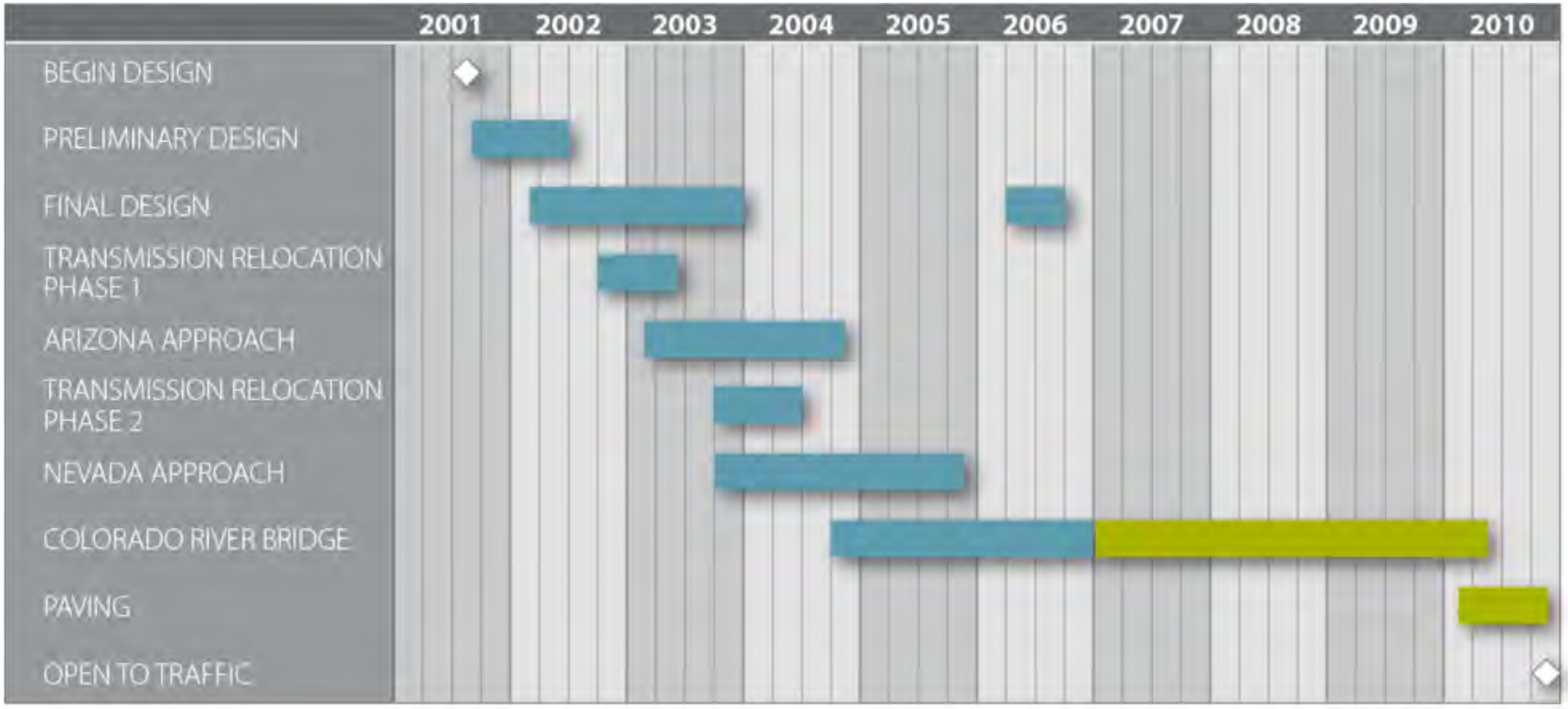


Project Features - AZ



Project Drive Through

Project Schedule



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Four Construction Segments

Contract	Contractor	Value
AZ Approach	Monks/VASTCO	$22M
NV Approach	Edward Kraemer & Sons	$30M
River Bridge	Obayashi/ Mitsubishi	$114M
Paving	Frehner & Las Vegas Paving	$15M
Total		$181M

Reaching the Project Site

- 3.3 million C.Y. of excavation
- 3.5 miles of new approach roadway
- Two years construction time

January 2005

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RIVER BRIDGE DESIGN CONCEPT

Various Bridge Types Considered

Cable-stay

Suspension

Arch

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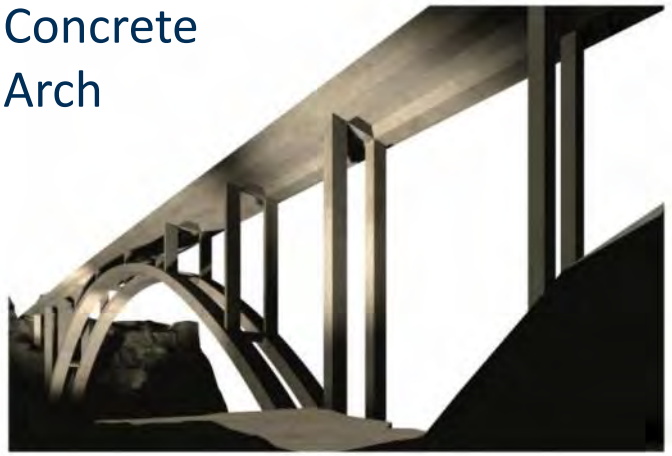
Various Arch Alternatives Studied

Steel Solid Rib Arch

Concrete Arch



Composite Arch

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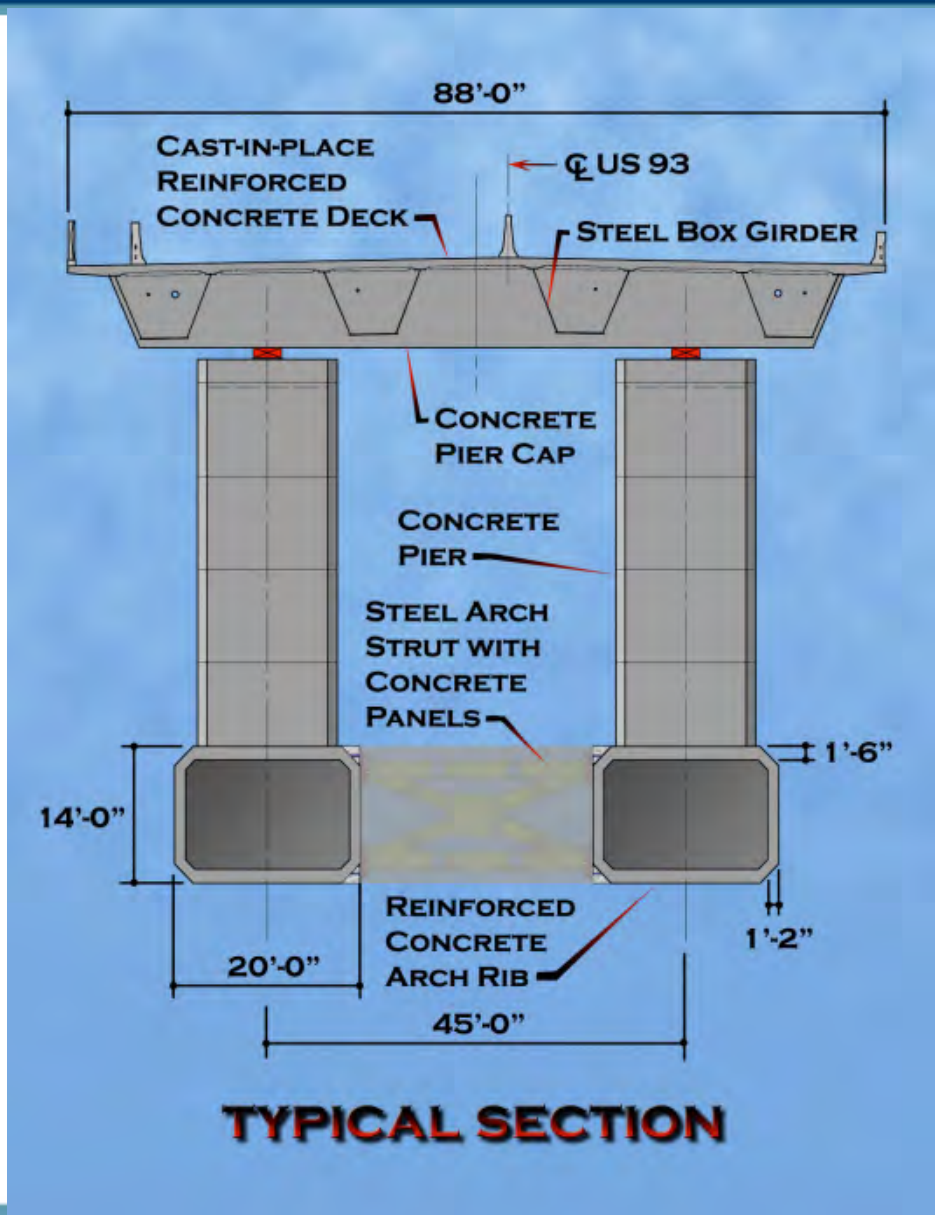
Concrete-Steel Hybrid Arch Bridge Selection

- Classical arch solution
- Met all project requirements
  - Constructability
  - Compatibility
  - Aesthetics
- Minimized costs
- Provided structural redundancy

Unique Design Features

- Hybrid Concept
- Arch ribs: cast-in-place concrete segmental
  - 10,000 psi
- Columns: precast concrete segmental
  - 6,000 psi
- Deck system
  - Steel tub girders
  - Cast-in-place concrete deck



Benefits of Unique Arch Solution

Design Feature	Benefit
Hybrid Design Concept	Best use of concrete and steel for efficiency and economy
Fully continuous deck system	Used to resist lateral loads
Twin arch ribs with diaphragms	Provided ductile frame action for seismic and wind resistance

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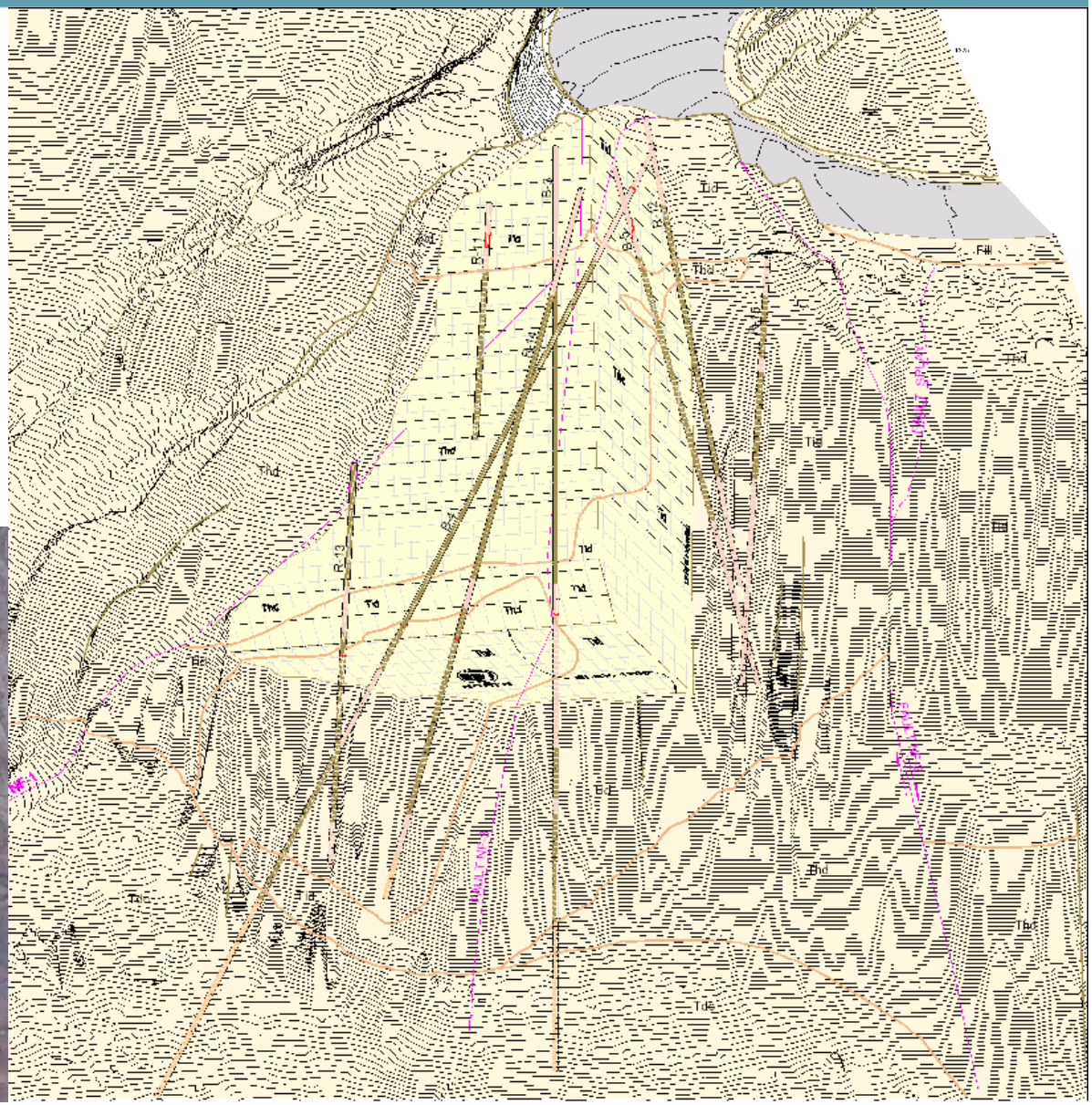
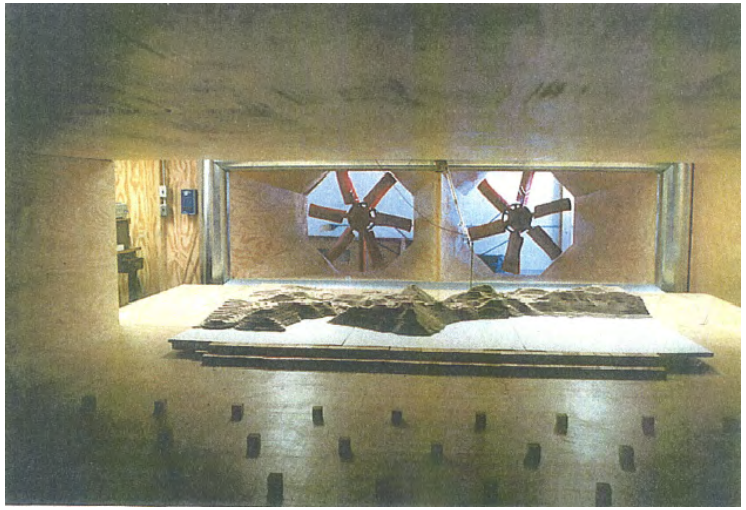
Geotechnical Investigations

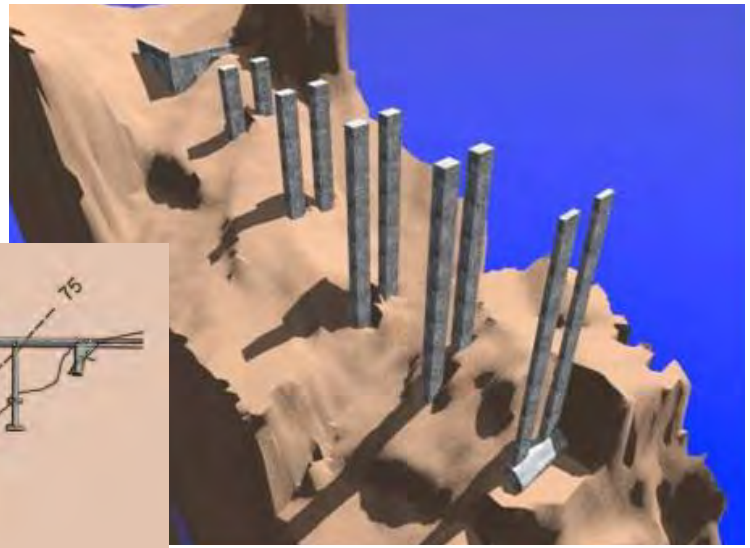
- Laser Scanning
- 3-D rock profiles
- Faulted & fractured rock conditions

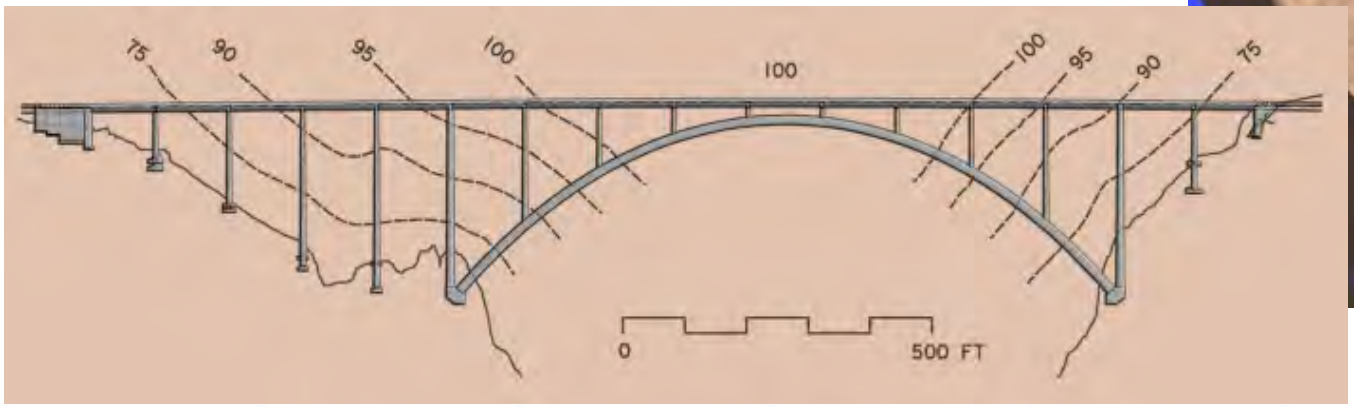


Site-Specific Wind Loading Studies

- No record at site
- Historical record at airport
- 1 year correlation study
  - Measured site conditions
- Normal winds at 100 mph, gusts to 125 mph
- Wind tunnel testing







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General Bridge Data

- Overall length 1,905’
- Main Span 1,060’
- Spandrel Lengths 120’
- Column height up to 288’
- Bridge located 1500’ downstream from dam
- Bridge deck about 900’ above river

RIVER BRIDGE CONSTRUCTION

Unique Aspects of Construction

Excavating and Constructing Foundations

- Competent rock
- Challenging site conditions
- 100’ deep cuts at skewbacks

Rock Containment to Protect Dam and River

Excavating and Constructing Foundations

- Completed NV Skewback excavation

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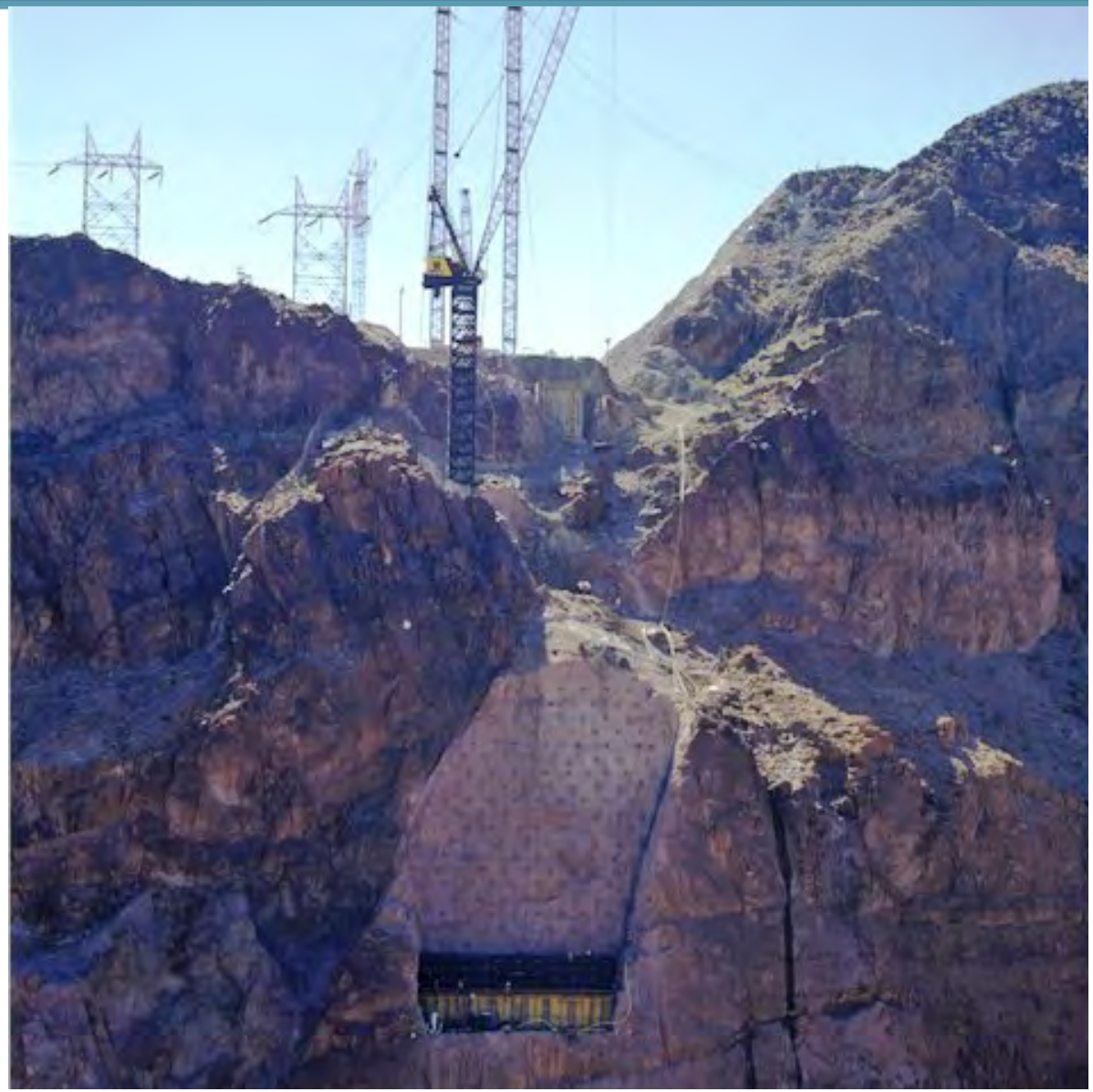
Excavating and Constructing Foundations

- Completed AZ skewback excavation



Skewback Foundations

- 2000 C.Y. of concrete each
- Night placement
- Cooling tubes
- Discovery Channel “Million Dollar Pour”

Local Precast Operation

- Precast Site 12 miles from bridge
- Over 400 column segments fabricated

Precast Operation

- Match Casting
- 10 ft. segment height
- 50 Ton highline capacity

Precast Operation

- Segment Checking

Precast Operation

- Segment Delivery

Approach Span Construction

Highline cableway system with 50-ton capacity

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Approach Column Construction

Temporary Bracing System

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New Highline Cableway System

New Highline: 2 – 300 ft. towers on each side w/3” cables

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Steel Tub Girder Superstructure

Efficient and light weight

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Main Span Arch Construction

Main Span Arch Construction

Local High-Performance Concrete Production

Pre-cooling with liquid nitrogen; night placement

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Main Span Cable-Stay Construction

- Temporary concrete towers
- First 6 arch segments cantilevered
- Alternate segments stayed
- 26 segments each side each rib
- 2 week cycle per segment
- 4 to 5 hours placement

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Main Span Cable-Stay Construction

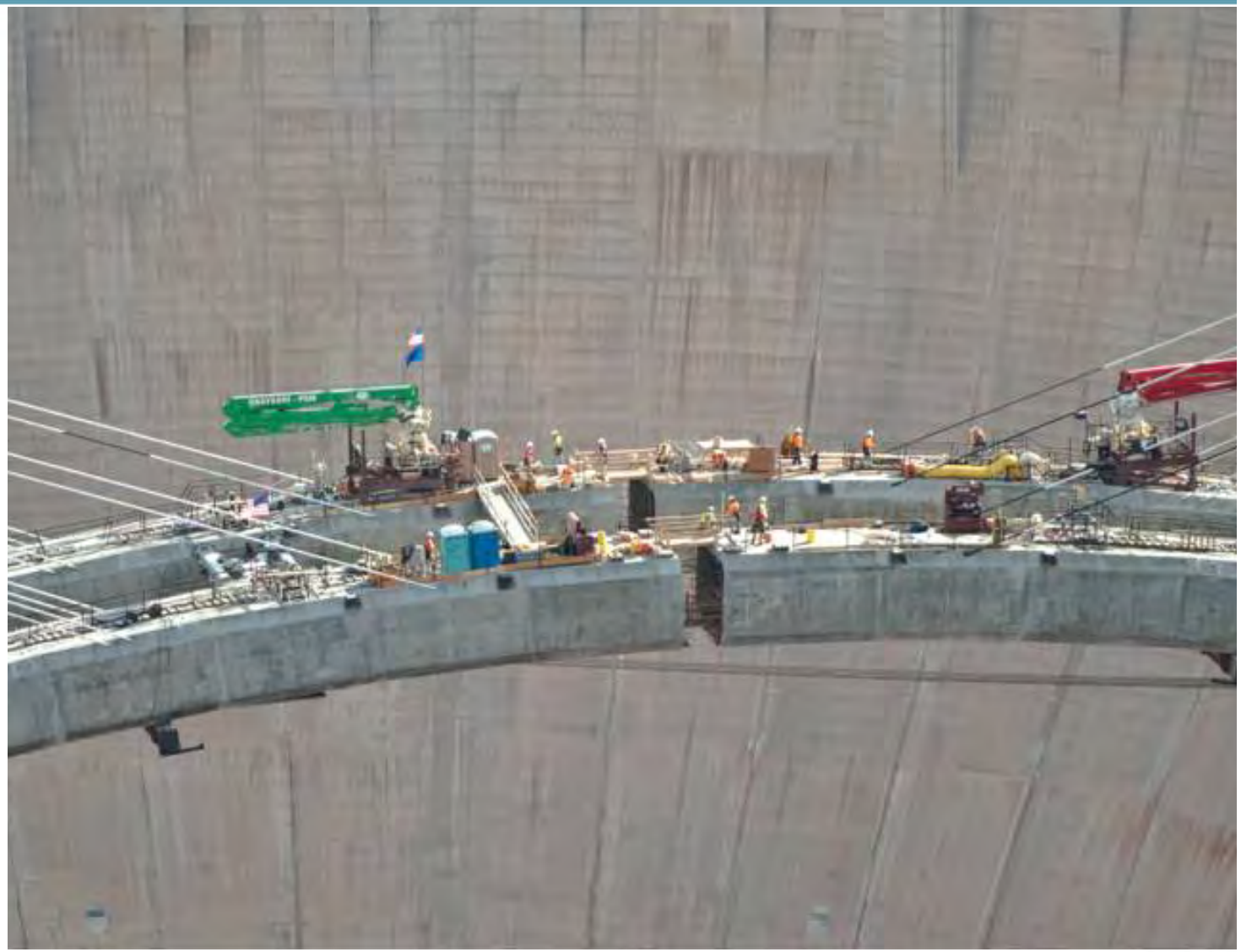
Main Span Cable-Stay Construction

Main Span Cable-Stay Construction

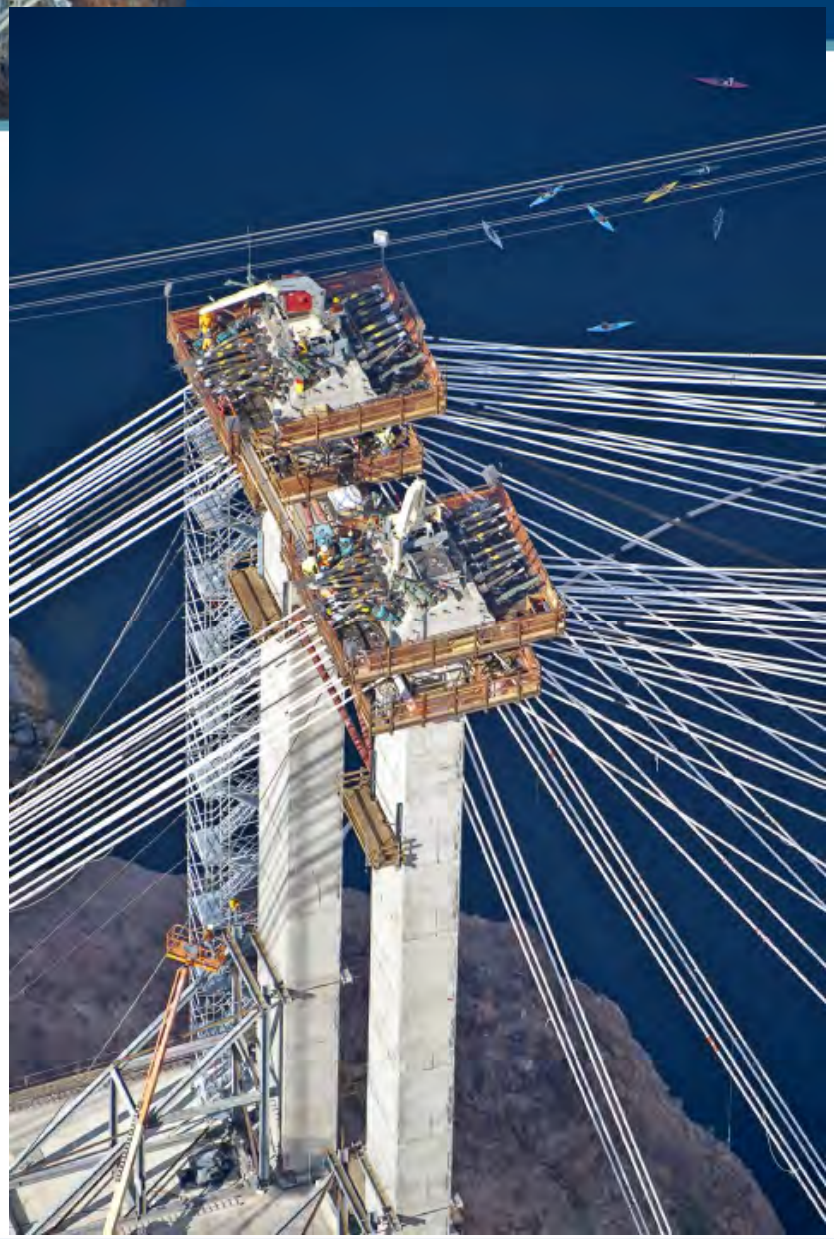
Main Span Cable-Stay Construction

Main Span Arch Closure

Main Span Arch Closure

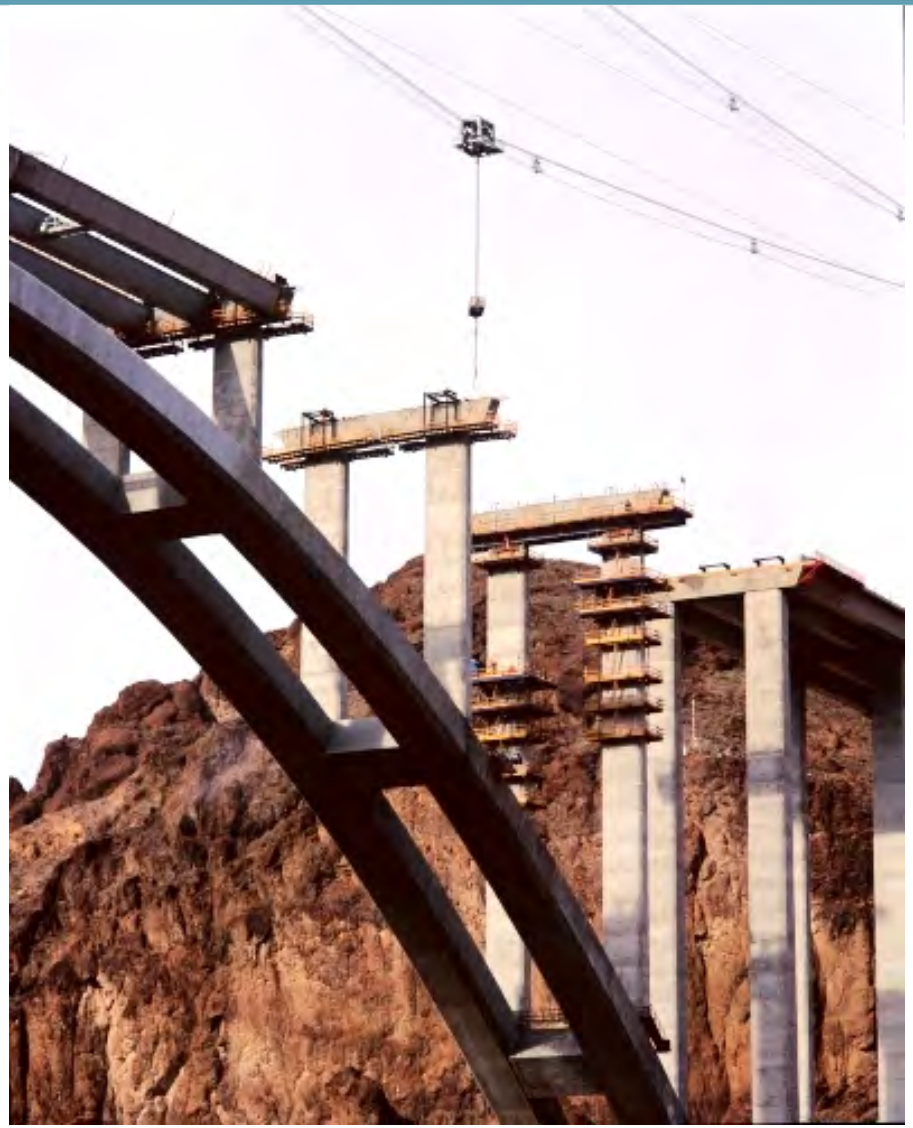


An Awesome Setting



Constructing Spandrel Columns

Completing Main Span



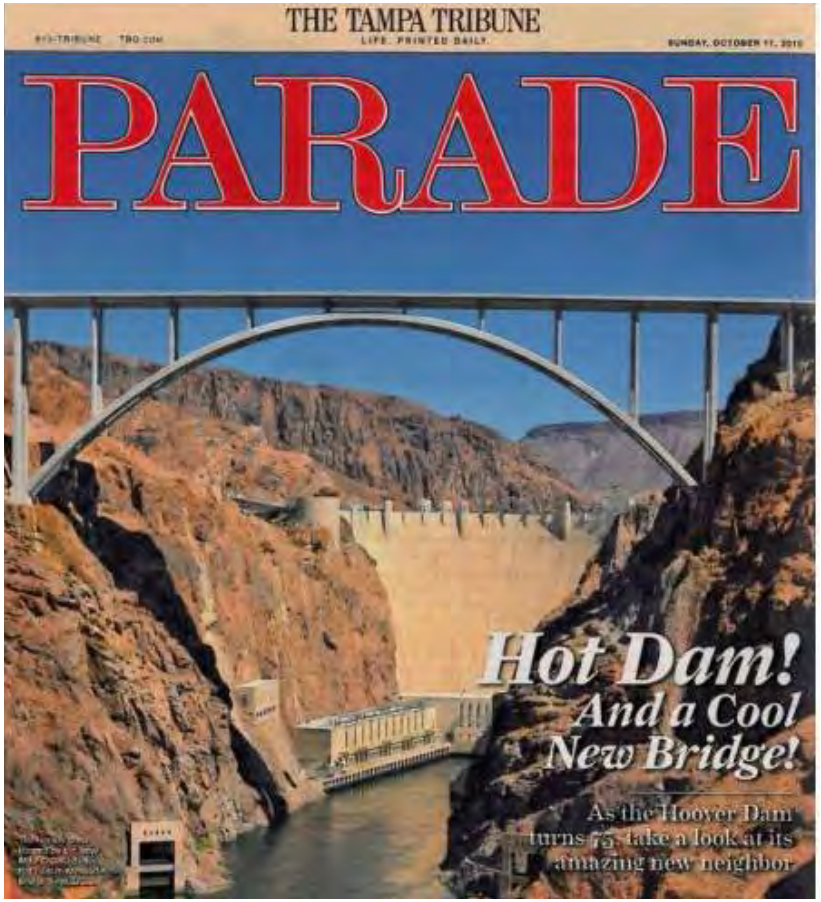
Initial Inspection

Completed on Revised Schedule, and on Budget

Improved Visitor Experience at Dam

Complimented an Existing American Landmark

Captured Public Imagination



The project has captured the interest of the general public as well as the engineering and construction industries

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Final Results and Metrics

- Completed on original $240 million budget without dispute or claim
- Includes river bridge, eight other bridges, and 3.5 miles of approach roadway
- River bridge is first concrete-steel hybrid arch system in the U.S.
- River bridge is longest concrete arch span (1,060’) in Western Hemisphere, and 4th longest in world.
- Has world’s tallest (288’) precast concrete columns of their type.

Hoover Dam Bypass & Colorado River Bridge

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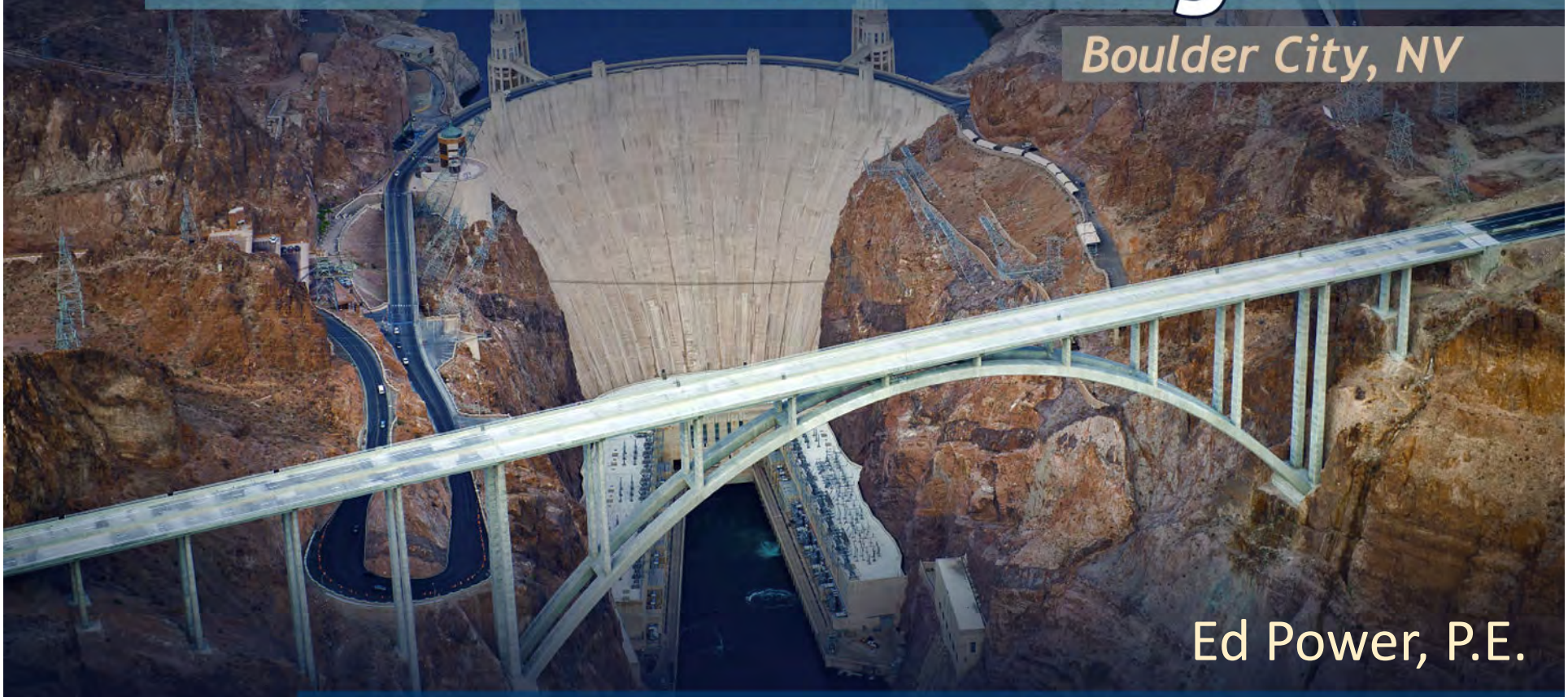
Boulder City, NV



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Questions?