Virtual Restoration of San Leandro Creek

Conceptual Channel Design for Minimum Flows

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LAEP 222

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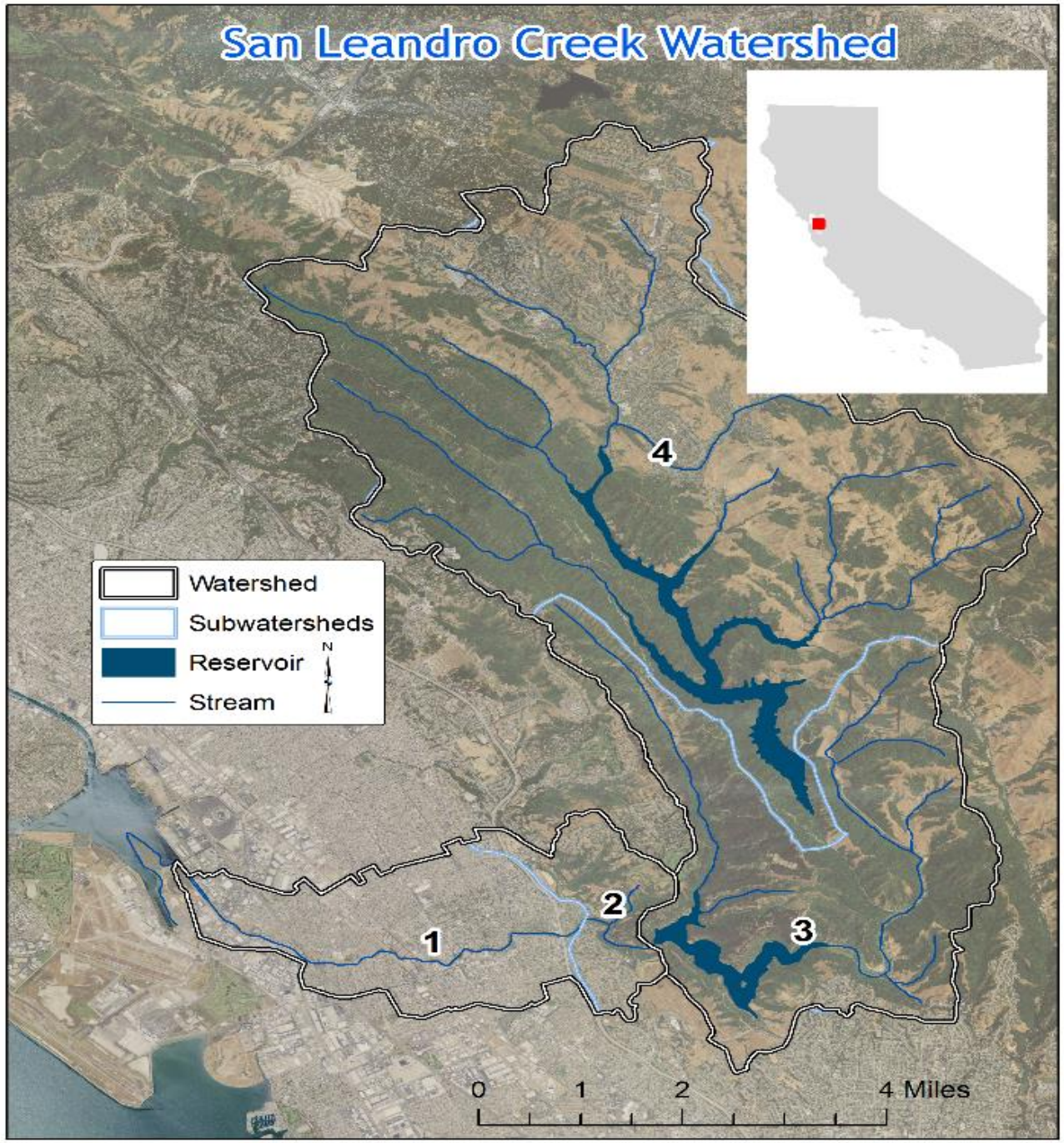


San Leandro Creek Watershed

Alameda County and Contra Costa County

- 48 sq. miles
- 21.7 miles long

Two Reservoirs:

- Upper San Leandro Reservoir (watersupply)
- Lake Chabot Reservoir (recreation)

Oakland & San Leandro above Oakland Airport

Minimal Releases from Chabot

- Lower San Leandro Creek (6.3 miles)

Multiple Agencies:

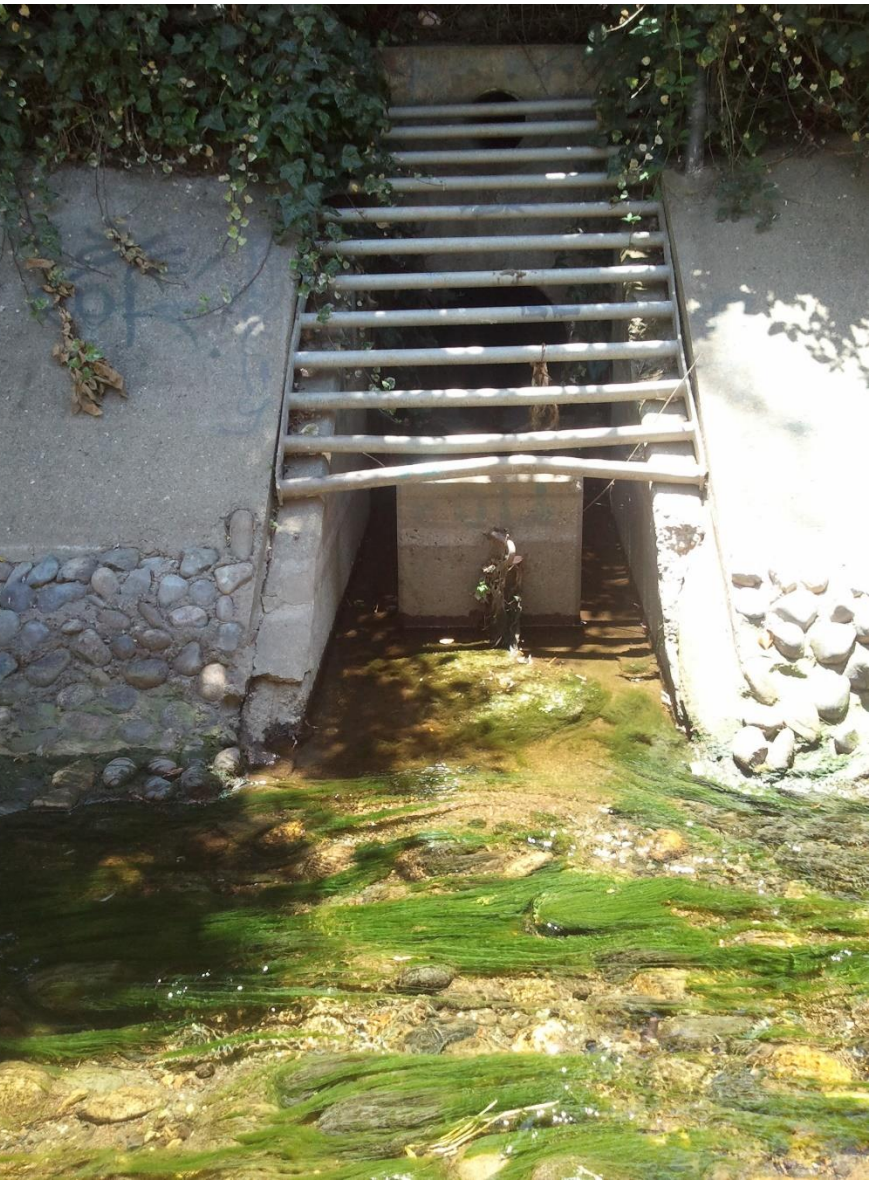
- East Bay Municipal Utility District (EBMUD)
- Alameda County Flood Control District
- East Bay Regional Parks District

Conceptual Channel Design

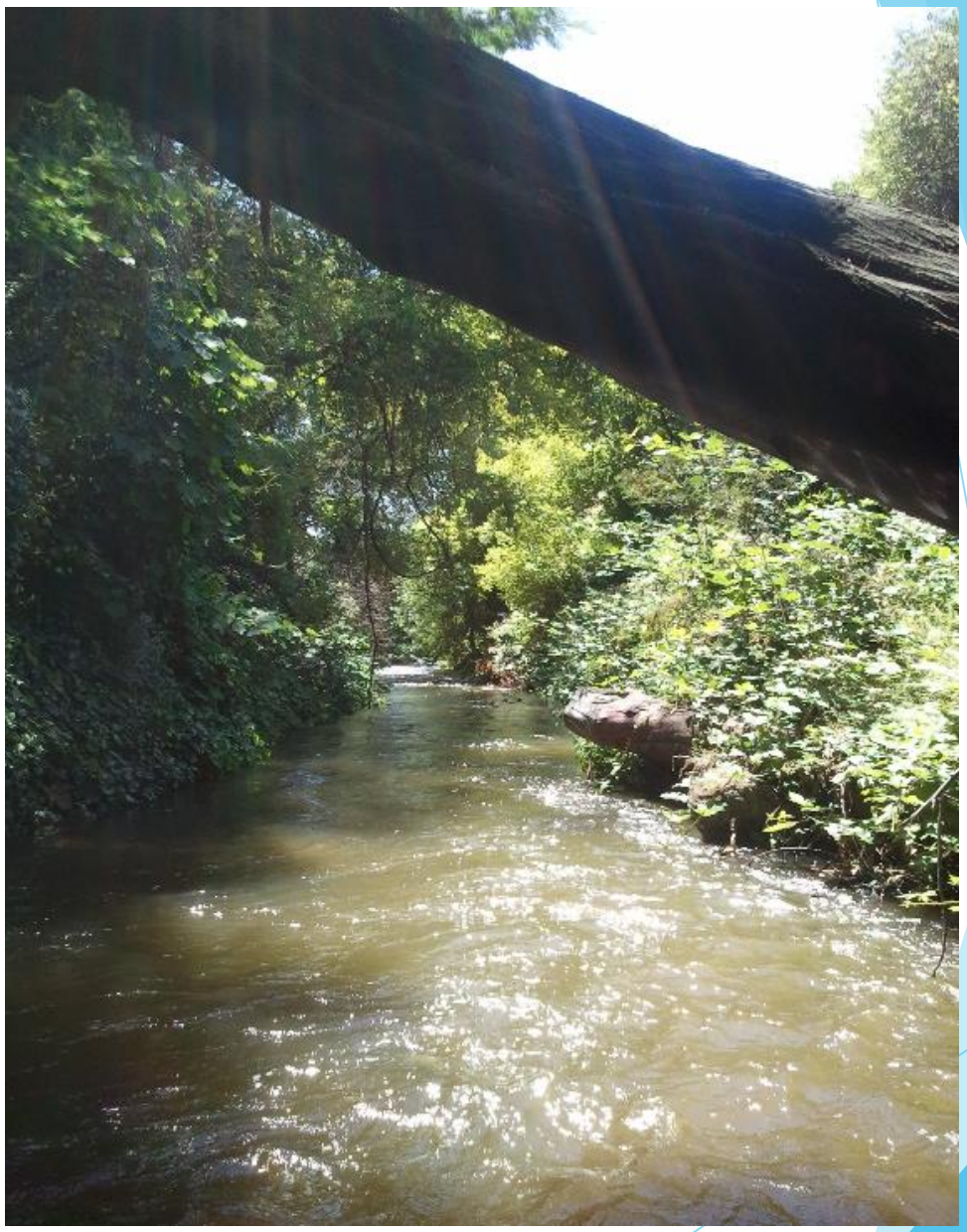
for enhancing greenways and blueways
in Lower San Leandro Creek Watershed
(Subwatershed 1 downstream, from Chabot)

Overview

1. Site Description
2. Conceptual Design
   A. Environmental Flows
   B. Virtual Restoration
   C. Design Goals
3. Methods – Approach
   A. Flows
   B. Channel
   C. Manning's Equation
   D. Modeling (HEC-RAS, HEC-EFM)
4. Results - Discussion

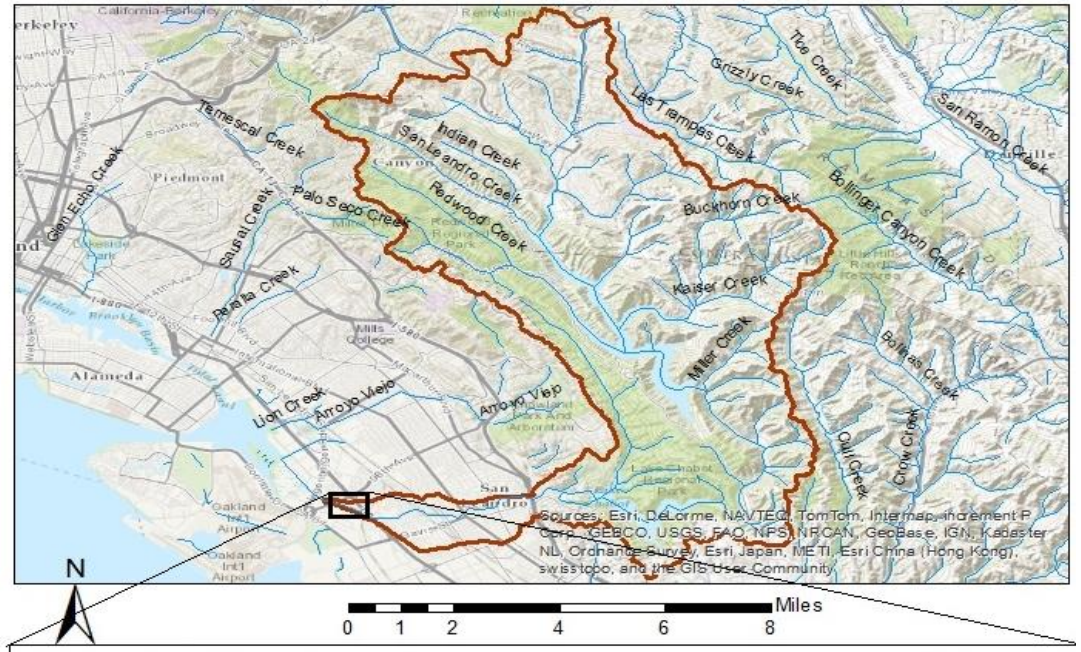


Typical Summer Flows (7/2012)

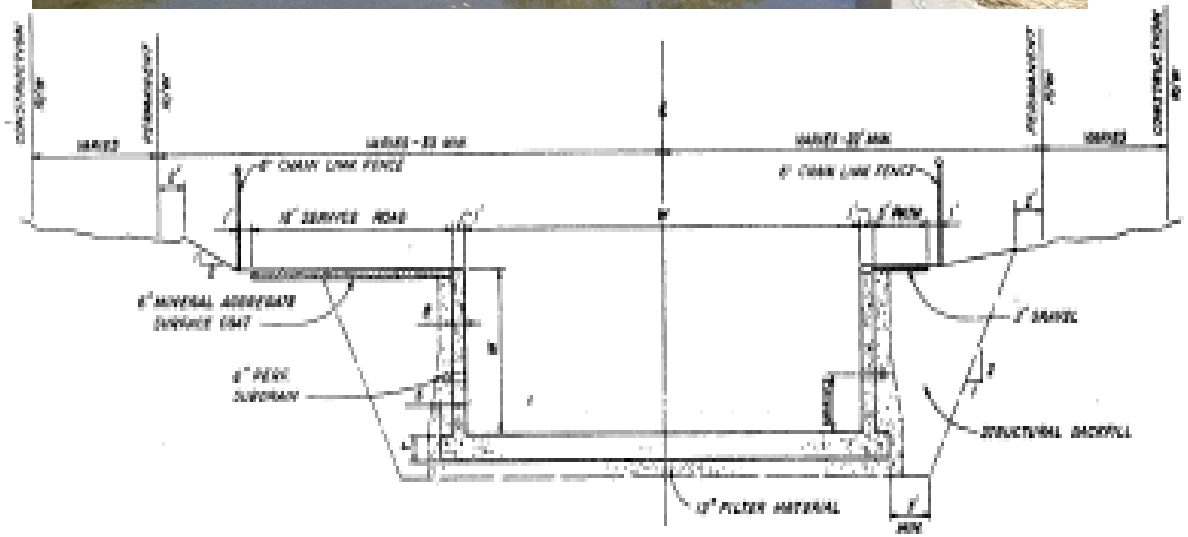


Atypical Summer Maintenance Flows (6/2012)

The Federal Channel – ACOE 1978

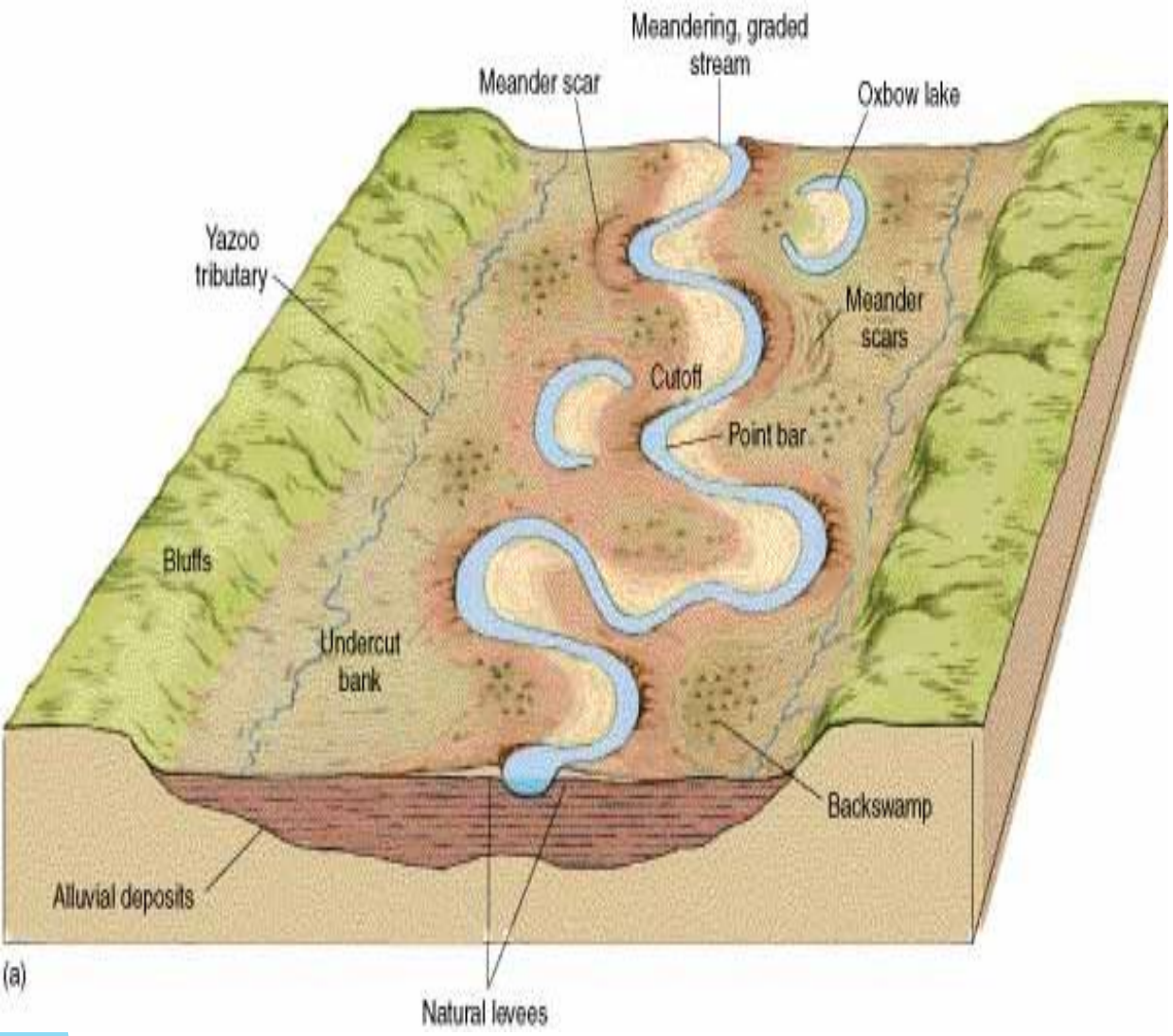


J. Wang 3.6.14



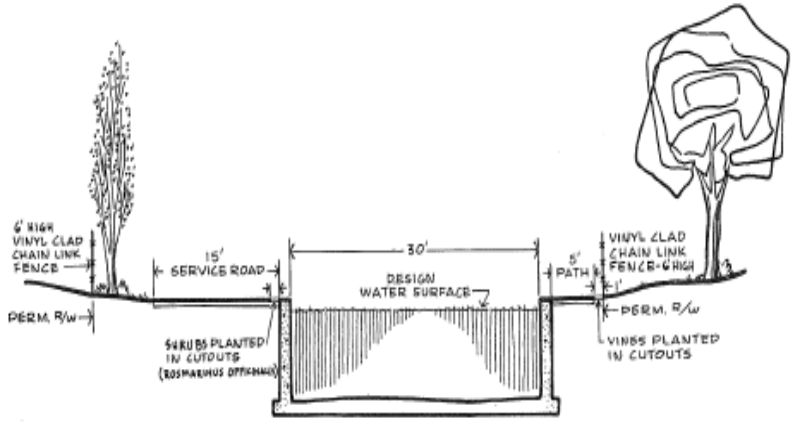
TYPICAL CHANNEL SECTION

Idealized Floodplain ~ *difficult in urban setting*



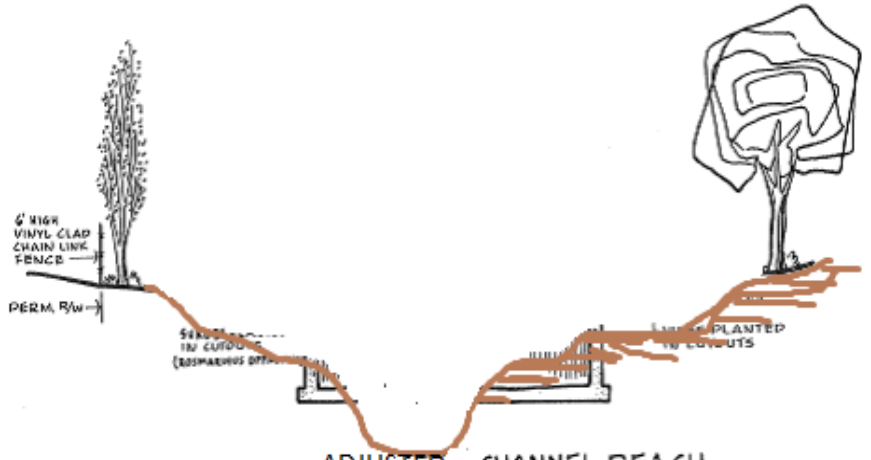
Design criteria

1. Create a **minimum flow channel** to enhance aquatic habitat (fish passage)
2. Create a more **gradual step-back floodplain** (slow flows, accommodate flood waters)
3. **Increase sinuosity** of within 4000 foot of Federal Channel reach (slow flows)
4. **Create step pools** between riffle sequences as habitat enhancement features
5. **Enhance riparian vegetation** that would provide shading and bank structure
6. **Obtain flows** needed to maintain minimum depths of 3 and 6 inches in low flow channel
7. Accommodate **2-yr, 100-yr flood capacity**



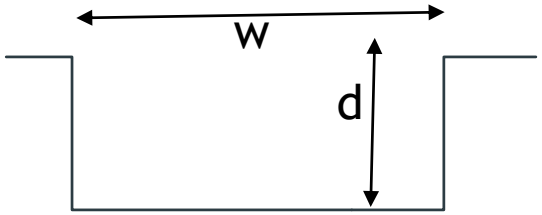
TYPICAL CONCRETE CHANNEL REACH

NO SCALE



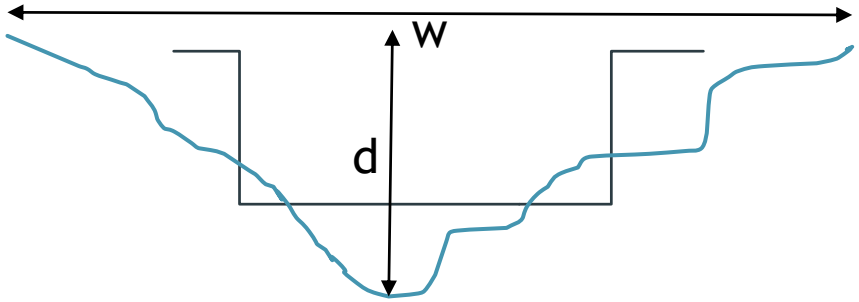
ADJUSTED CHANNEL REACH

NO SCALE



Rectangular:

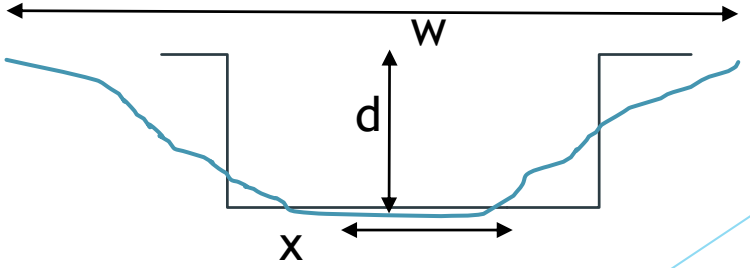
d(max) = 9, w/2 = 17, n=0.02



Triangular: d(max) = 11, w/2 = 34, n=0.035

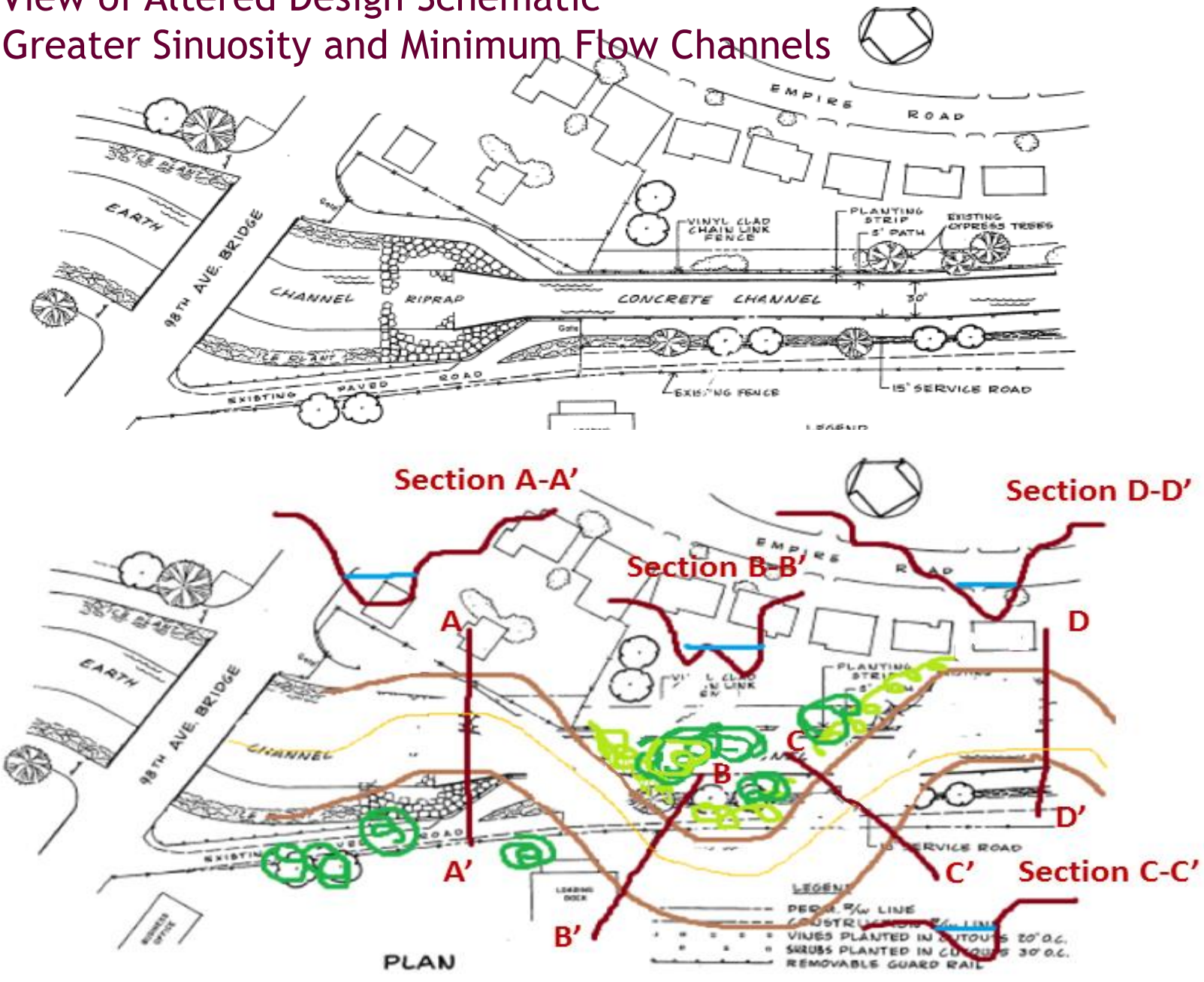
Manning's Equation

$$Q = VA = \left(\frac{1.49}{n}\right) AR^{\frac{2}{3}} \sqrt{S} \quad [U.S.]$$



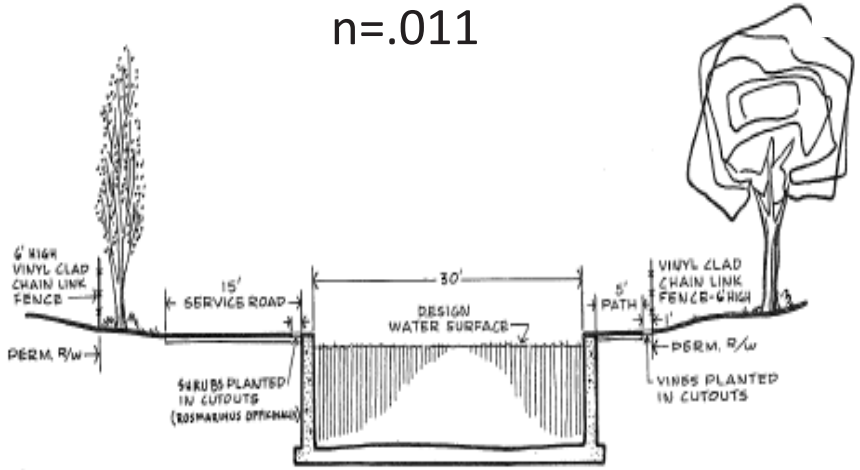
Trapezoidal: d(max) = 9, w/2 = 16, x=4, n=0.035

Plan View of Altered Design Schematic with Greater Sinuosity and Minimum Flow Channels

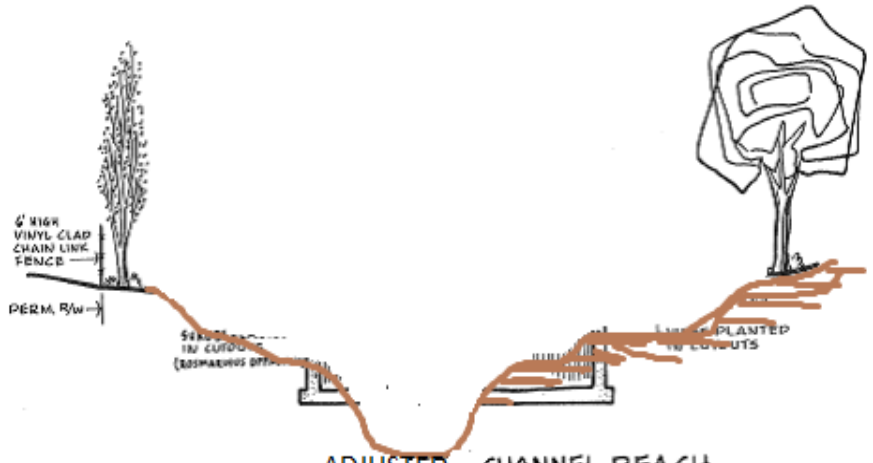


Rectangular Channel		(34x9)
Q (cfs)	d (ft)	V (ft/s)
3000.21	5	17.65
234.59	1.00	6.90
121.84	0.67	5.35
20.85	**0.23**	**2.67**
0.359	0.02	0.53

n=.011



TYPICAL CONCRETE CHANNEL REACH
NO SCALE

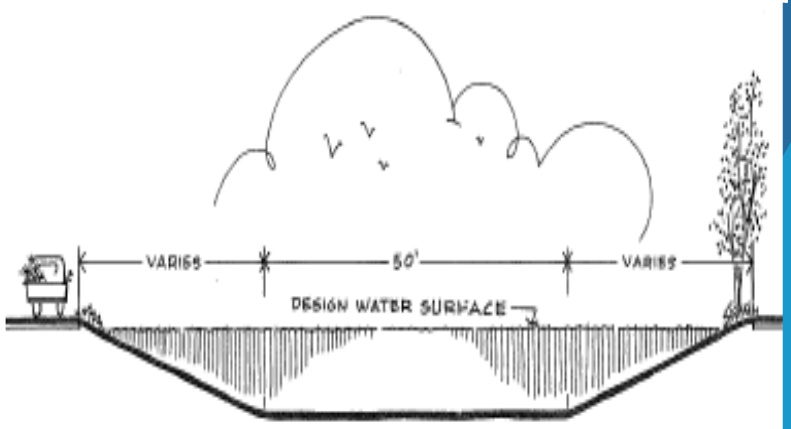


ADJUSTED CHANNEL REACH
NO SCALE

n=.035

Triangular Channel		(68x11)
Q (cfs)	d (ft)	V (ft/s)
2539.41	11.00	6.79
120.19	1.73	2.04
20.59	0.60	1.01
4.79	**0.25**	**0.56**
0.019	0.009	0.06

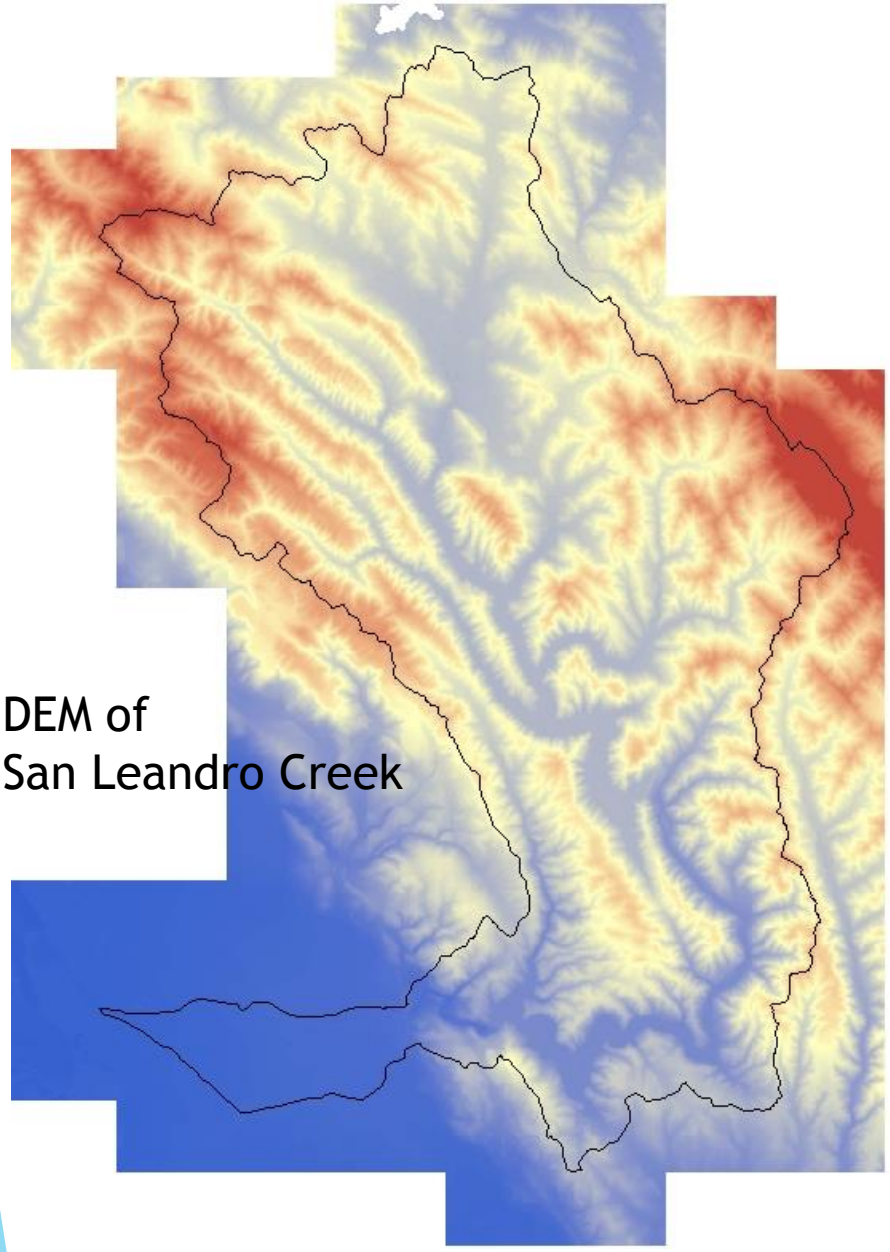
Trapezoidal Channel		(36x9)
Q (cfs)	d (ft)	V (ft/s)
2909.17	9.00	8.98
802.82	4.00	5.58
125.33	1.3	2.68
8.05	**0.25**	**0.89**
0.026	0.01	0.09



TYPICAL SECTION-EARTH CHANNEL REACH

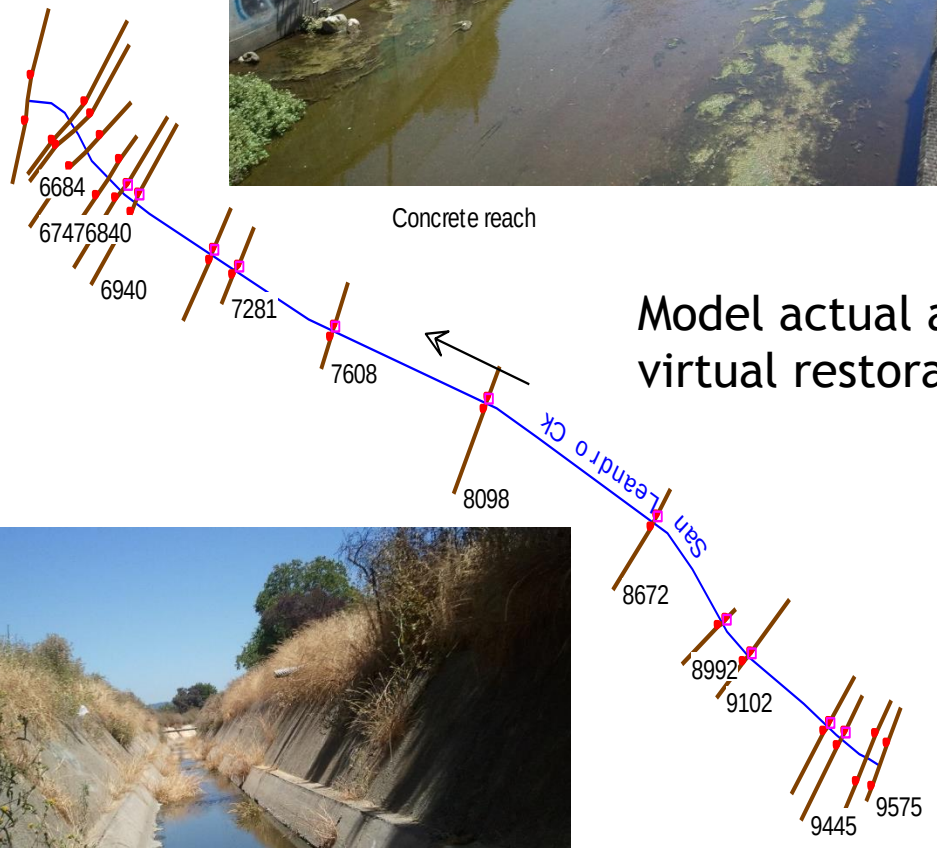
n=.035

Potential Application of HEC-GeoRAS

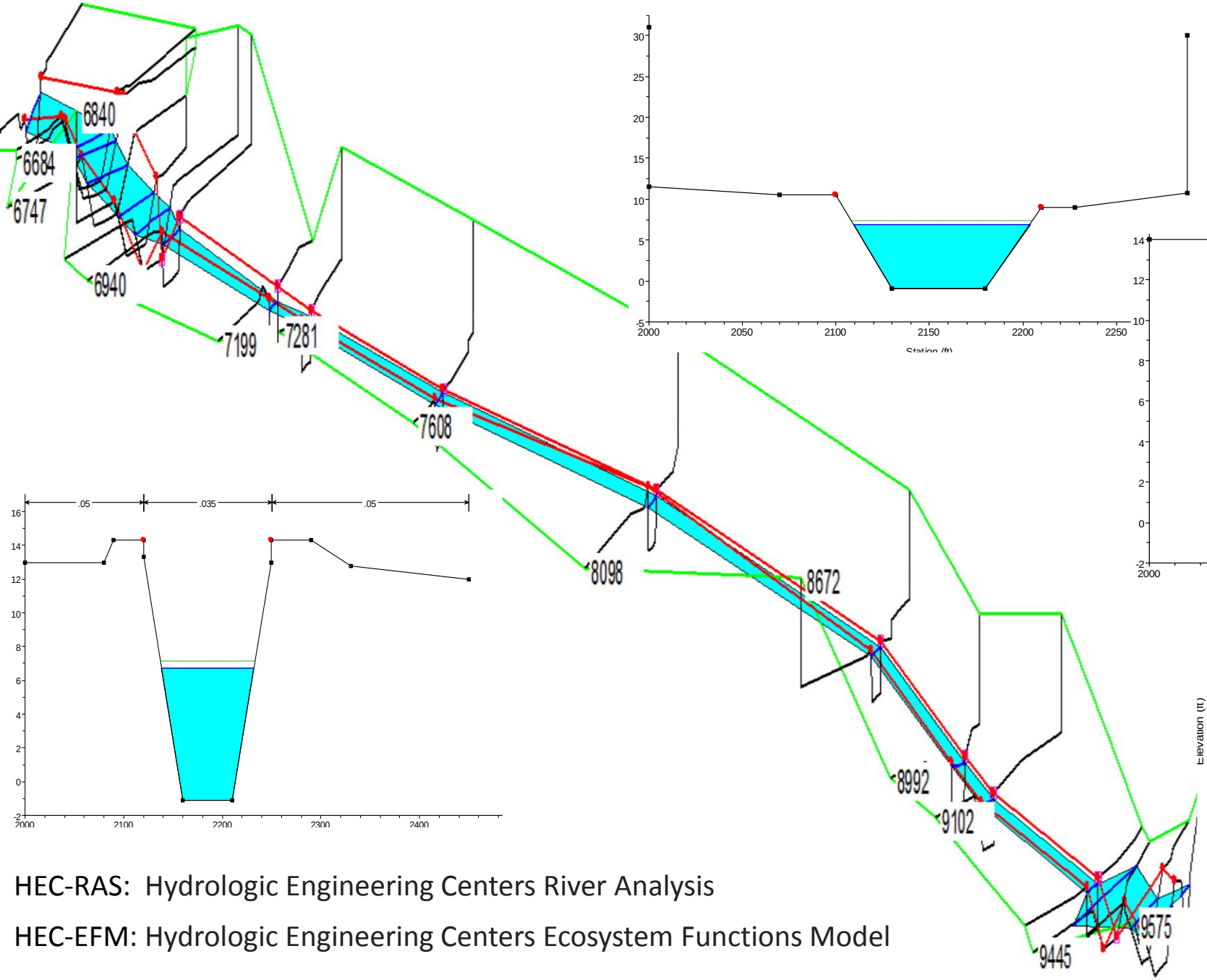


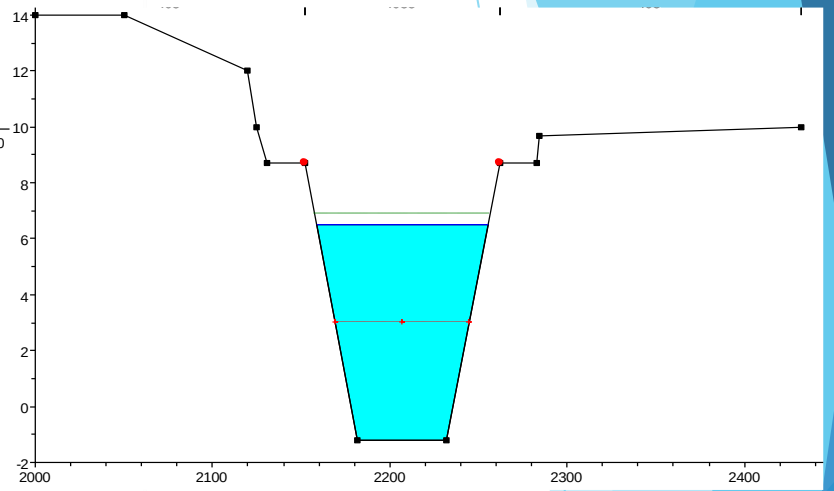
DEM of
San Leandro Creek

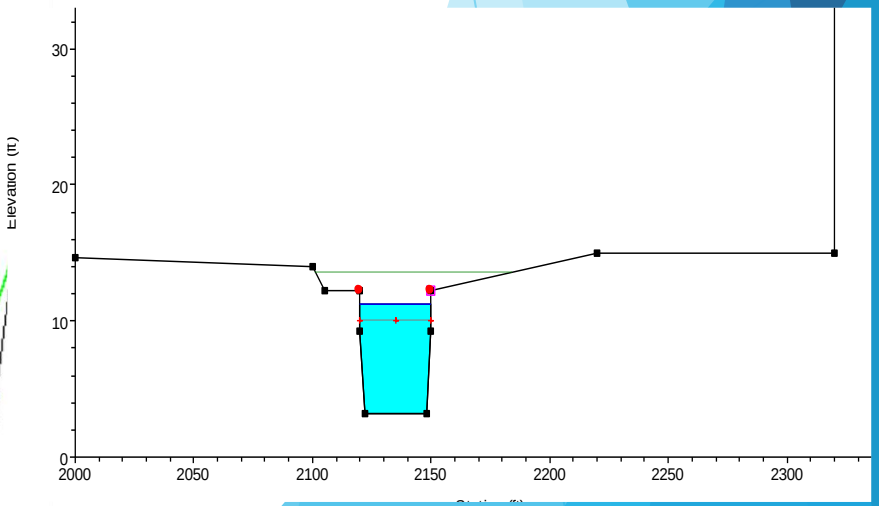
Concrete reach



Model actual and
virtual restoration







HEC-RAS: Hydrologic Engineering Centers River Analysis

HEC-EFM: Hydrologic Engineering Centers Ecosystem Functions Model

Conclusion

- Virtual Restoration and Environmental Flow Modeling can help conceptualize restoration opportunities and design outcomes
- A modified more triangular cross-section or other low flow channel with 2x top width will provide both flood control capacity and minimum flow benefits
- The modified “triangular” channel can maintain 3” and 8” of flow depth at 1/5th the discharge volume required for current rectangular concrete Federal channel (5-20cfs vs. 20-120 cfs)
- Additional sinuosity and roughness from earth, rock and vegetation will help slow flows, and improve habitat (for fish and people)
- Models such as HEC-RAS and HEC-EFM can help verify hydraulic response