Identifying Local Flood Risk Reduction Projects with a High Benefit-Cost Ratio in Placerville, California

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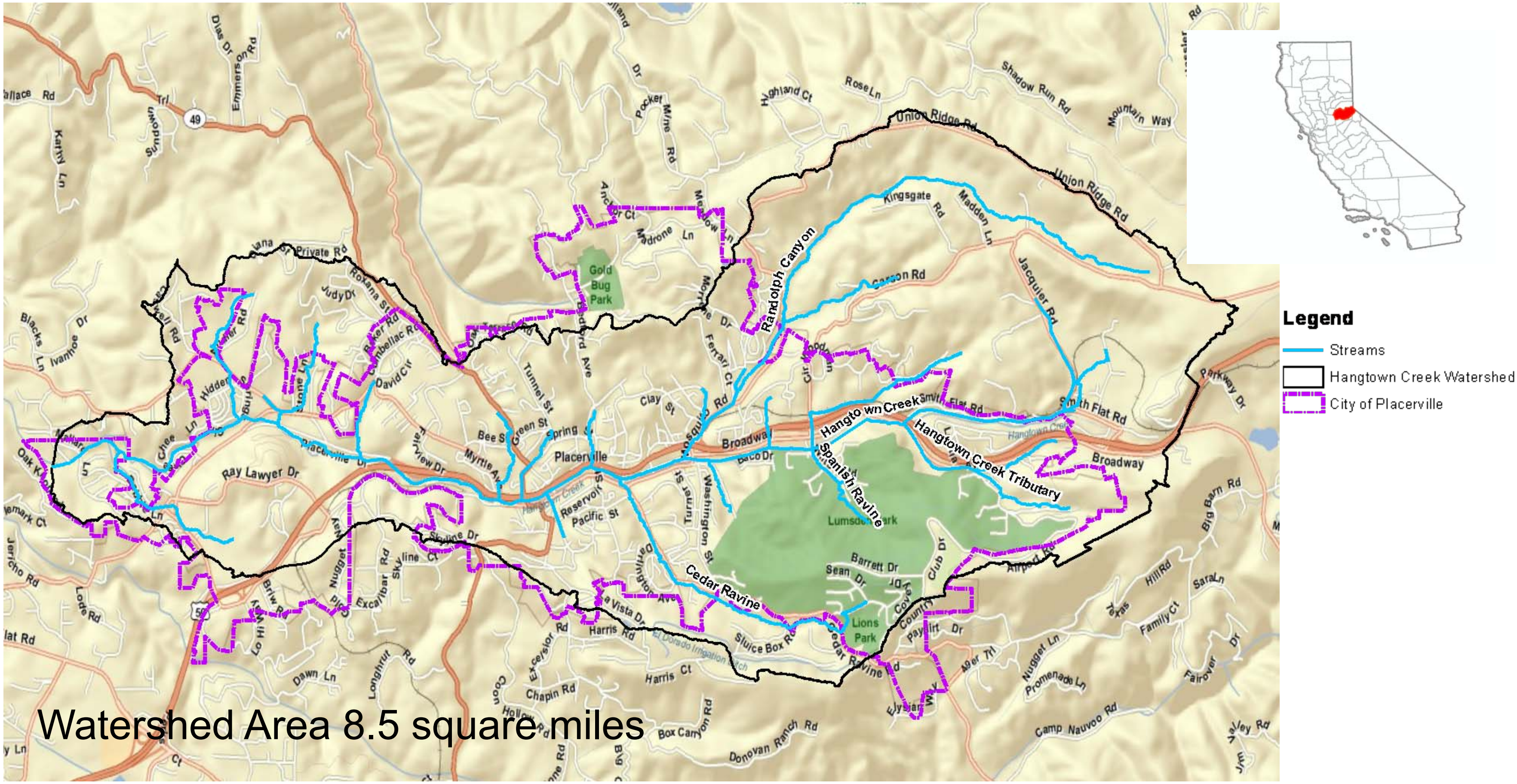
RBF Consulting,
A Baker Company

Special Thanks: Nate Stong, PE
City Engineer
City of Placerville

Introduction

- Flood Risks in the City of Placerville
  - City Development Occurred during California Gold Rush
  - Challenges facing the City
    - Hangtown Creek
    - Central Business District
    - Historic Buildings

Study Area



Watershed Area 8.5 square miles

At-Risk Buildings

At-Risk Buildings

At-Risk Buildings

Historical Flooding

December 31, 2005 – about a 10-year event

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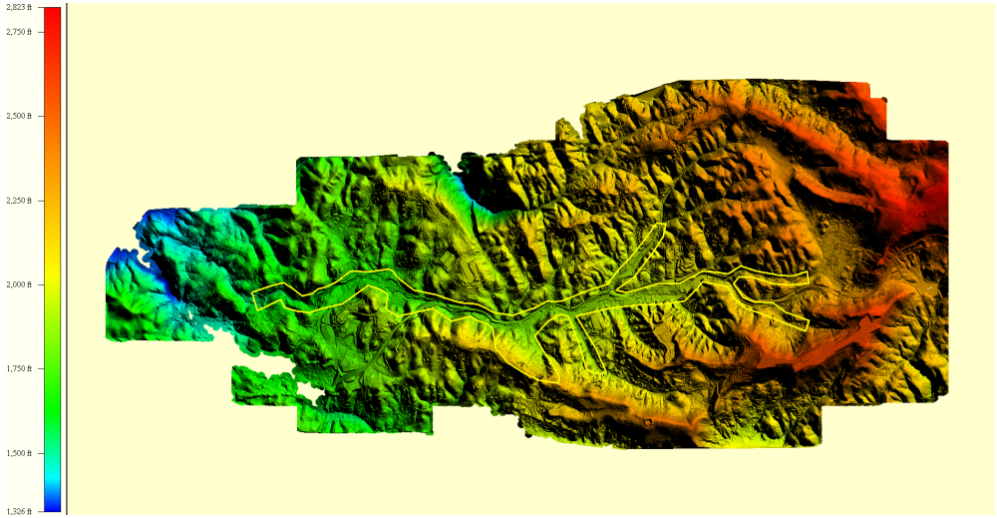
Hangtown Creek Comprehensive Watershed Plan

- Obtain new topography and aerial photography of the City and watershed
- Compute flow rates for the Hangtown Creek watershed
- Determine flood depths along Hangtown Creek
- Investigate the feasibility of projects to reduce flood risks

Aerial and LiDAR Survey Data Collection



LiDAR Data

6-inch color orthoimagery

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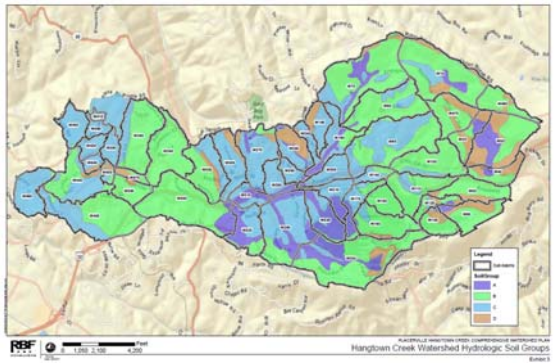
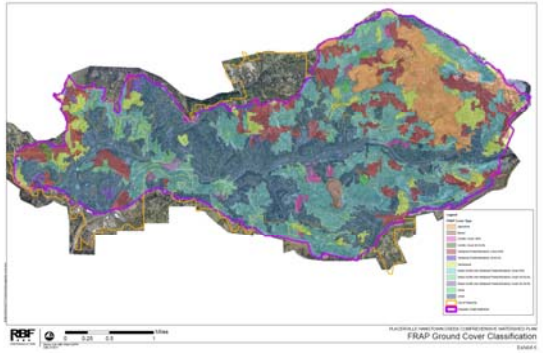
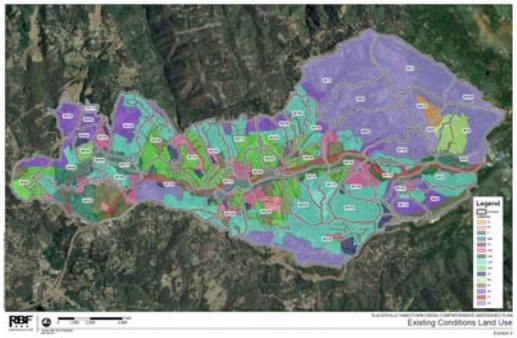
Existing Conditions Hydrology

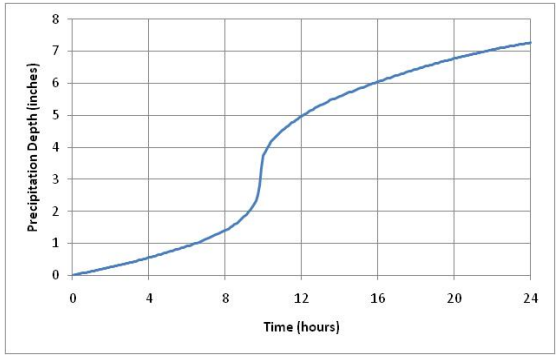
Watershed Delineation → Soil Data → Ground Cover Data →

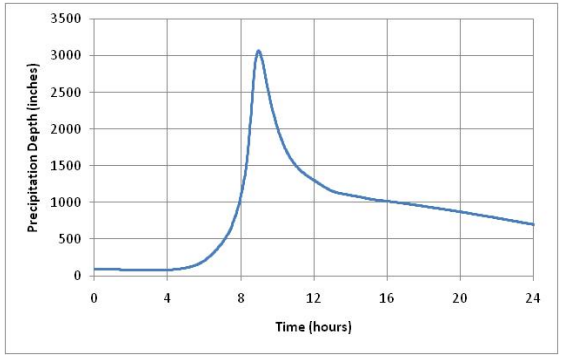




Land Use Data → Precipitation → Discharge







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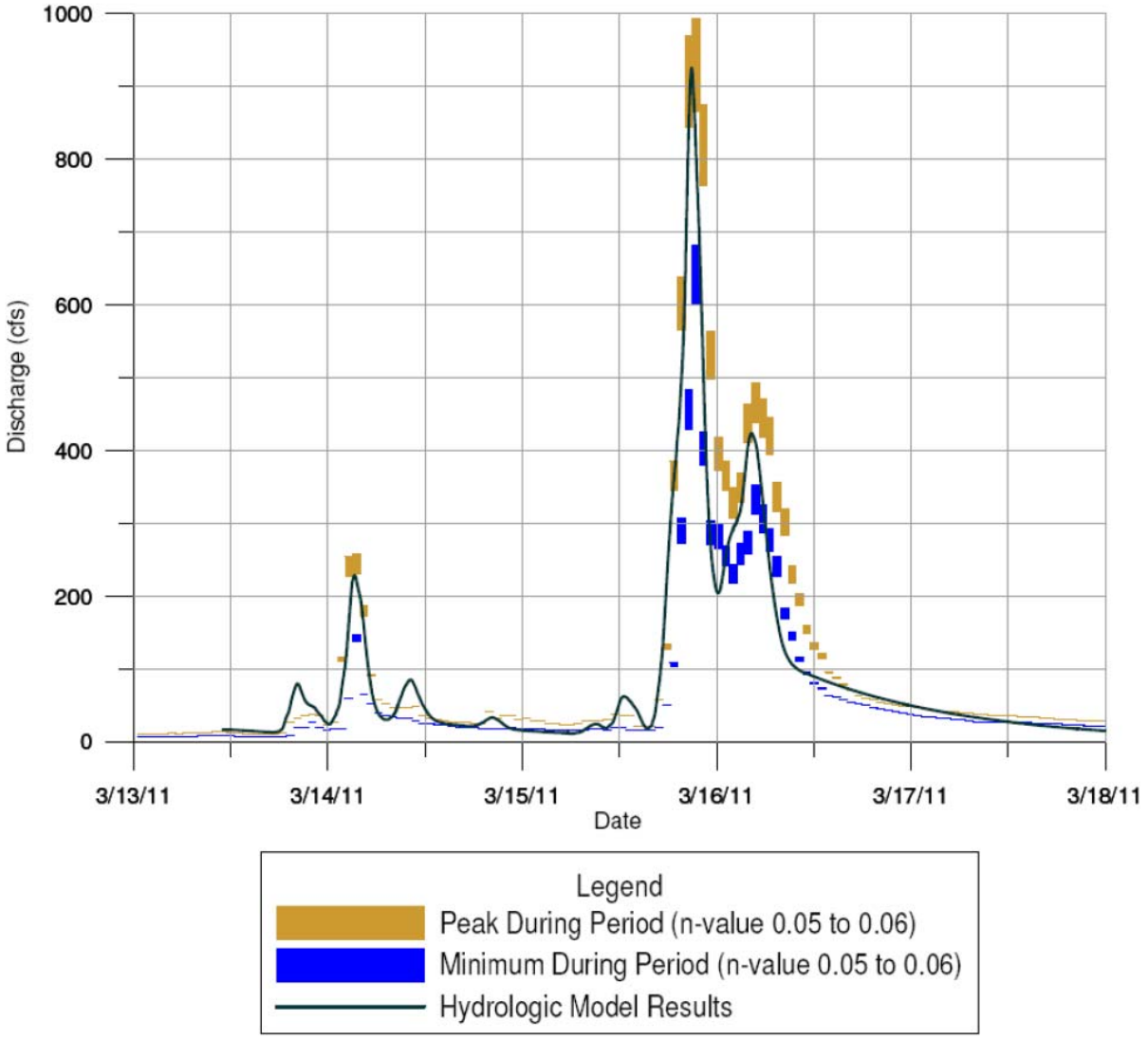
Hydrologic Model Validation



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Discharges at Key Locations from Current and Previous Studies

Description	HMS Node	Tributary Area (sq. mi)			10 year			25 year			50 year			100 year		
		RBF	FEMA	DA	RBF	FEMA	DA	RBF	FEMA	DA	RBF	FEMA	DA	RBF	FEMA	DA
Near Upstream end of Hangtown creek	J72	1.56	1.6	-	496	270	-	645	-	-	755	410	-	864	490	-
Broadway and Mosquito Road	J56	2.79	-	-	855	-	996	1115	-	-	1306		-	1495	-	1850
From Randolph Canyon	J104	4.57	4.7	-	1205	760	-	1599	-	-	1890	1140	-	2180	1380	-
From Cedar Ravine	J33	5.55	5.6	-	1385	1000	1750	1839	-	-	2174	1540	-	2508	1870	3219
Main Street and Sacramento Street	J18	7.80	8	-	1947	1580	-	2568	-	-	3027	2410	-	3483	2920	-
Downstream end of Hangtown creek	J30	8.56	-	-	2102	-	-	2769	-	-	3261	-	-	3749	-	-

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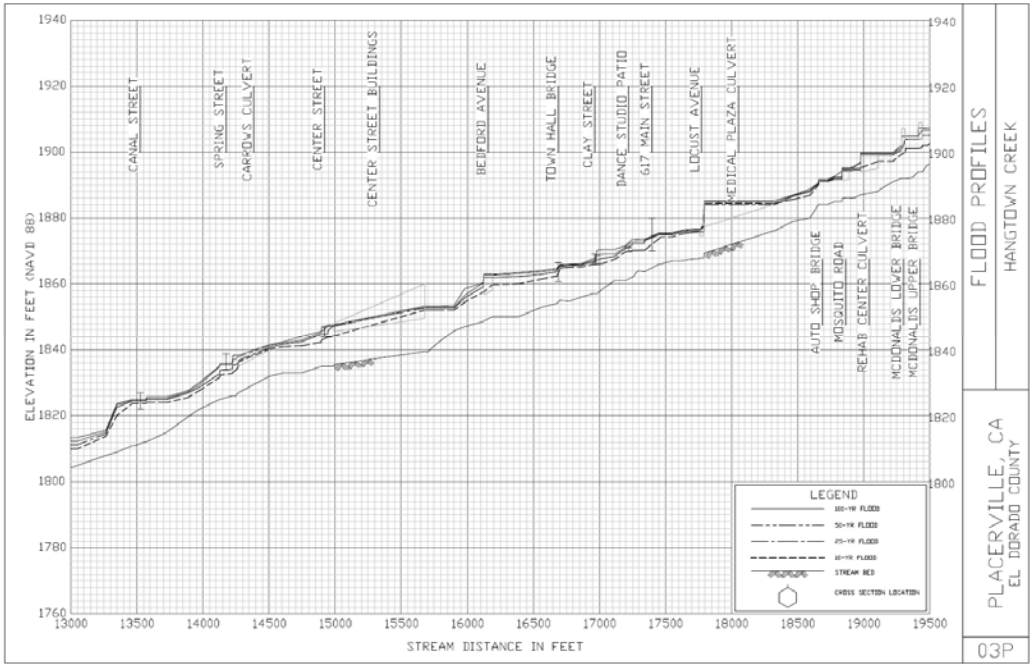
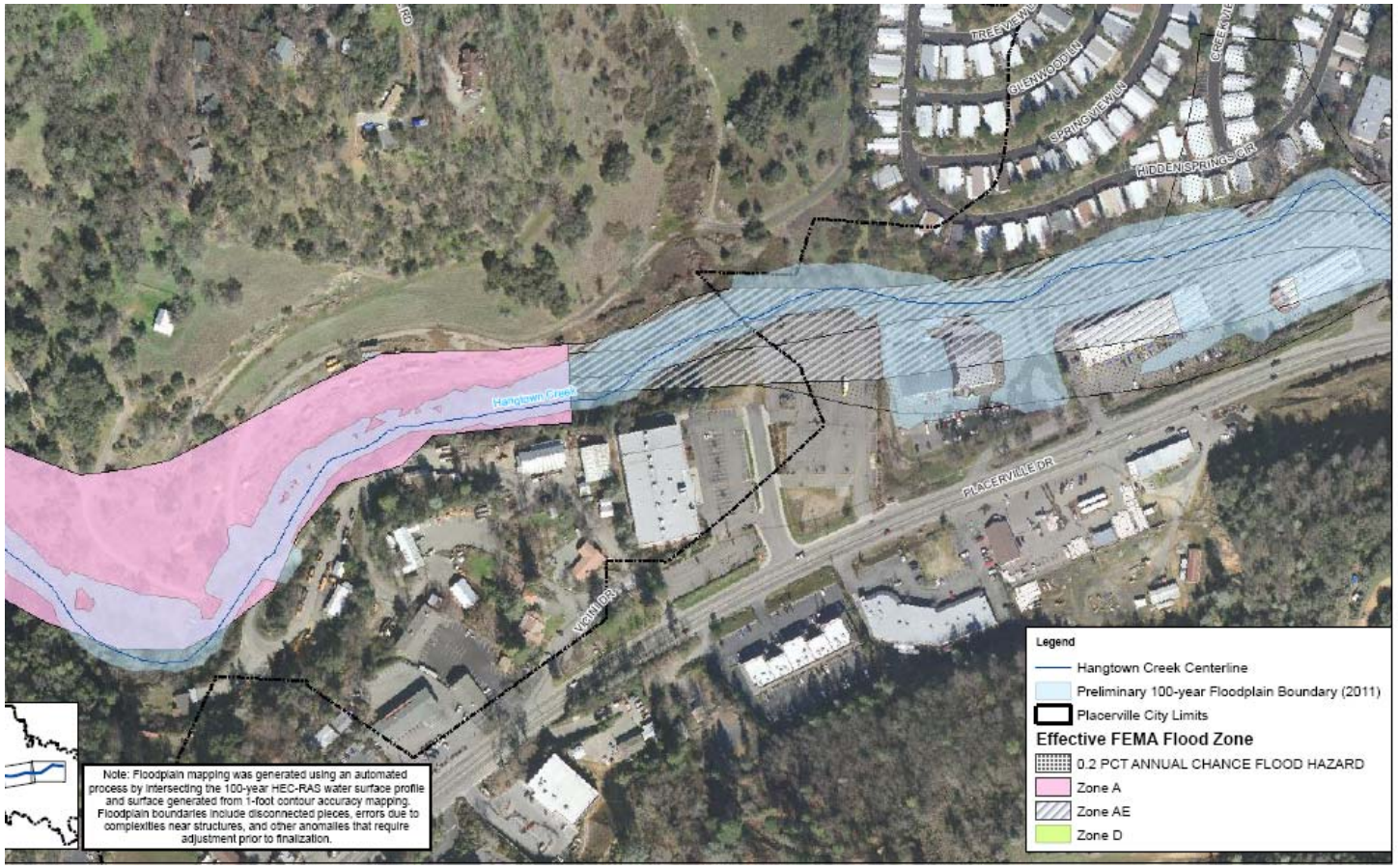
Flood Profiles

- Flood profiles for 10-, 25-, 50- and 100-year storm events



New vs. Old Floodplains



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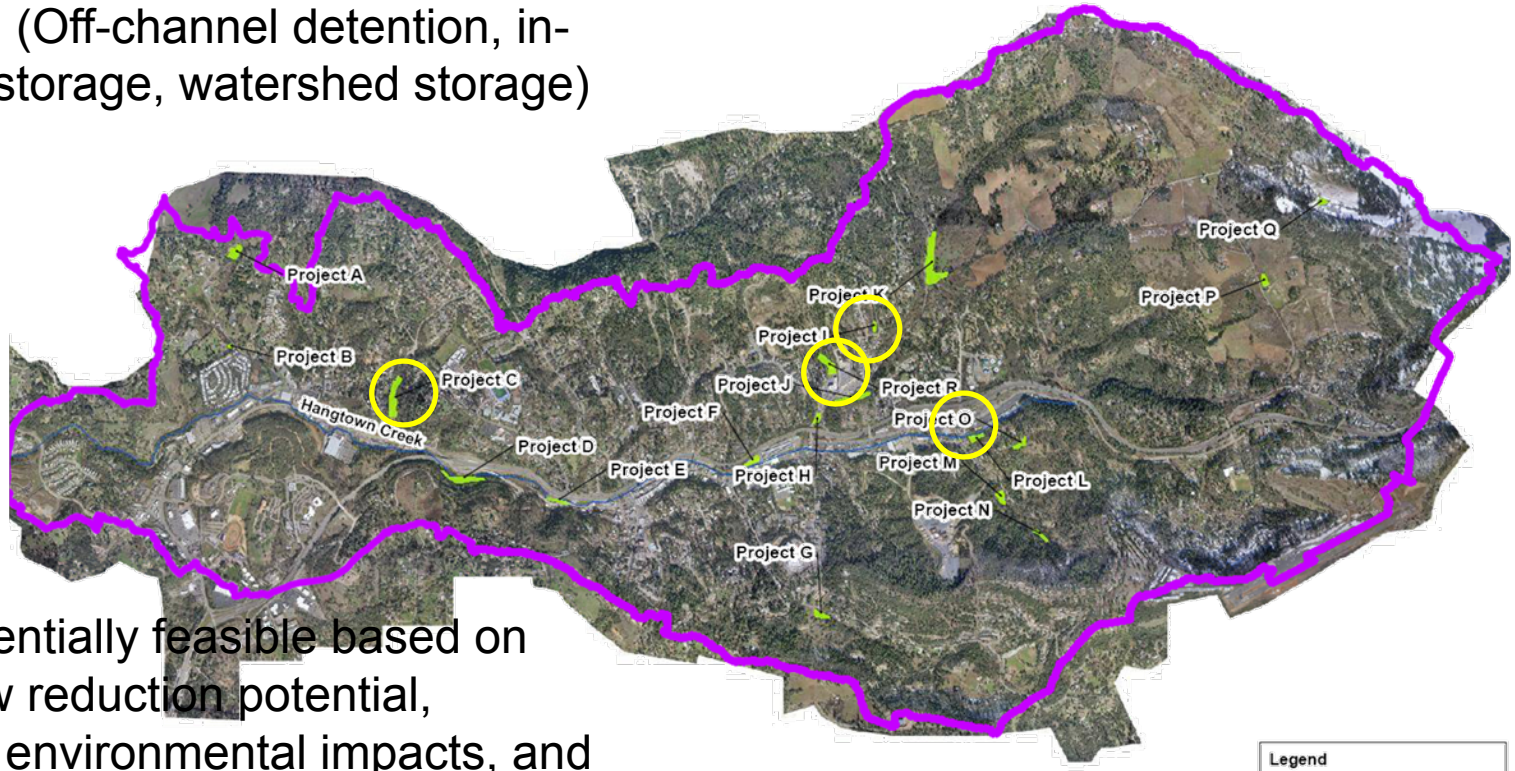
Evaluation of Potential Flood Damage Reduction Projects

- Eighteen potential project locations identified (Off-channel detention, in-channel storage, watershed storage)



- Four potentially feasible based on peak flow reduction potential, potential environmental impacts, and projected costs

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Potentially Feasible Projects

Id	Location	100-year Flow Reduction	Limiting Factor
C	Placerville Dr behind Polaris	100 cfs	Benefits small number of downstream properties
I	Between Morrene Dr & Hawks Landing Ct	50 cfs	Storage capacity limited by existing development
L	Upstream from Wiltse Rd	100 cfs	Topographical constraints
R	Behind El Dorado Irrigation District Bldg	50 cfs	Limited tributary area & potential embankment height

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Potential Project I

Looking Upstream

Potential Project L

Looking Upstream

Looking Downstream

Potential Project M

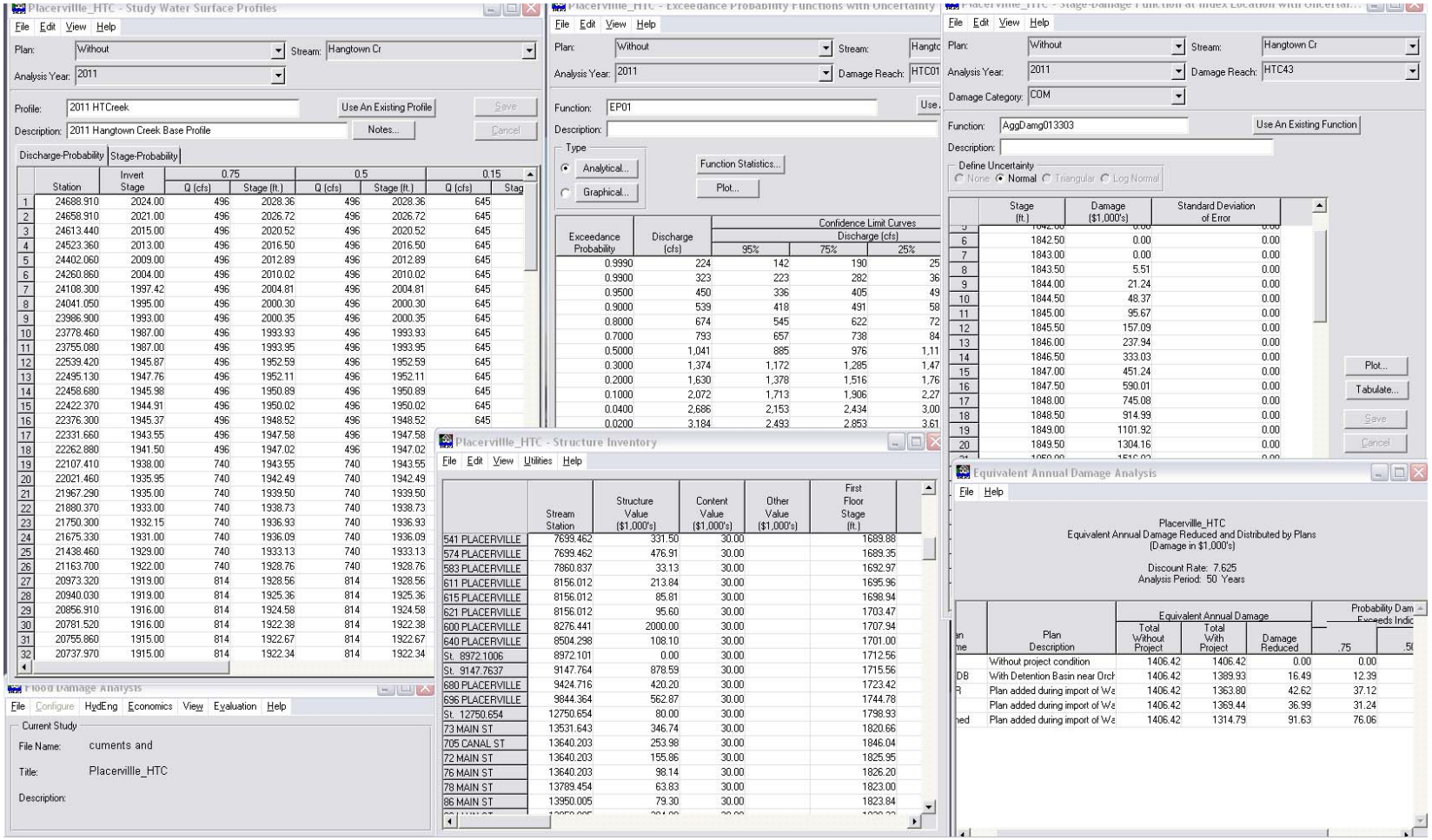
Looking Upstream

Looking Downstream

HEC-FDA

- Tool to Quantify Flood Damage Reduction Benefit ($)
- Flows from HEC-HMS model
- HEC-RAS water surface profiles for 10, 25, 50, 100 year events
- Finished Floor Elevations of 250 structures from LiDAR and field investigation
- FEMA Depth-Damage curves
- Structure Value Estimates from County Assessor

HEC-FDA



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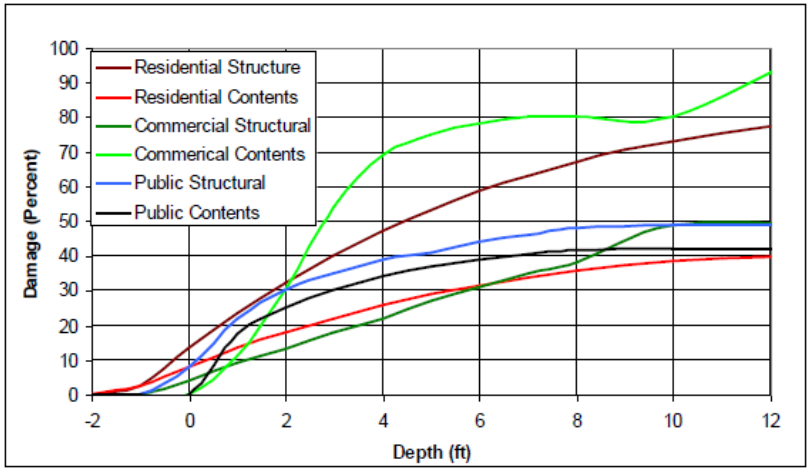
Project Benefit Analysis

- Estimate of damage with and without each and all four projects
- Parcels with structures impacted by 100-yr floodplain (250 structures)
- Finished floor elevation from LiDAR and field estimates



Hydrologic Event	Event Probability	Event Damage Existing Conditions	Event Damage With Project I or R	Project I or R Event Benefit	Event Damage With Projects C, I, L, R	Projects C, I, L, R Event Benefit
10-year	0.10	$ 4,202,000	$ 4,105,000	$ 97,000	$ 3,955,000	$ 247,000
25-year	0.04	$ 6,445,000	$ 6,336,000	$ 109,000	$ 6,062,000	$ 383,000
50-year	0.02	$ 7,696,000	$ 7,613,000	$ 83,000	$ 7,336,000	$ 360,000
100-year	0.01	$ 9,278,000	$ 9,168,000	$ 110,000	$ 8,934,000	$ 344,000

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Other Project Benefits

- More Difficult to Quantify
  - Recreation
  - Vehicle Damage Prevention
  - Habitat Preservation and Enhancement
  - Groundwater recharge
  - Infrastructure Protection
  - Emergency Services and Public Safety
  - Mitigation Banking

Project Costs and Benefits

Table 18: Equivalent Annual Damage to Buildings

Scenario	Equivalent Annual Damage	Equivalent Annual Damage Reduced
Existing Conditions	$1,407,000	--
With Project C	$1,399,000	$8,000
With Project L	$1,390,000	$17,000
With Project I or R	$1,364,000	$43,000
With Projects C, L, I and R	$1,315,000	$92,000

Table ES-1: Estimated Cost and Expected Benefit Summary

Project	Estimated Capital Costs	Comprehensive Project Costs	Comprehensive Damage Reduction	Benefit-Cost Ratio
C	$862,000	$962,000	$173,000	0.2
I	$766,000	$866,000	$1,068,000	1.2
L	$855,000	$955,000	$402,000	0.4
R	$832,000	$932,000	$1,017,000	1.1
C, I, L, R	$3,315,000	$3,715,00	$2,167,500[1]	0.6

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Conclusions

- Even small, local projects may provide flood reduction benefit
- Projects with significant flood damage reduction benefits may produce benefit/cost ratios greater than 1 while targeting high frequency storm events
- Grant funding applications may be more attractive with higher b/c ratios (Consumnes American Bear and Yuba Rivers Integrated Regional Water Management Plan)
- Combine with Local Development Projects as Mitigation Bank

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