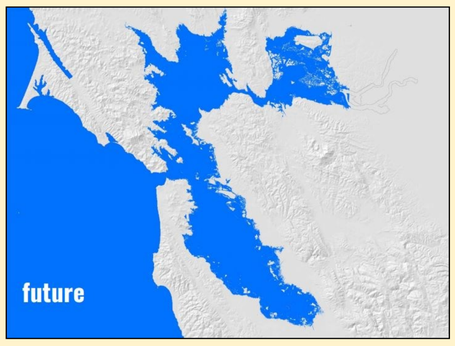
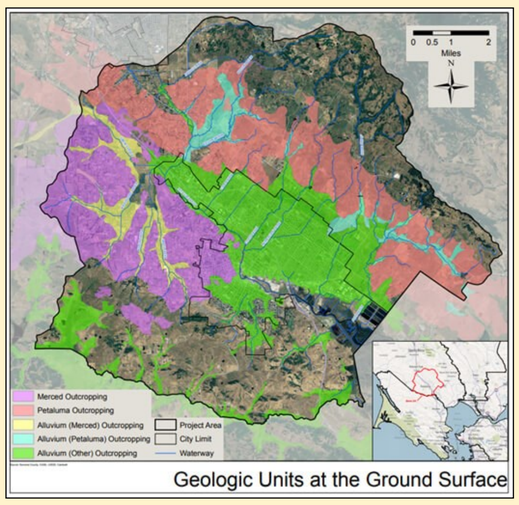
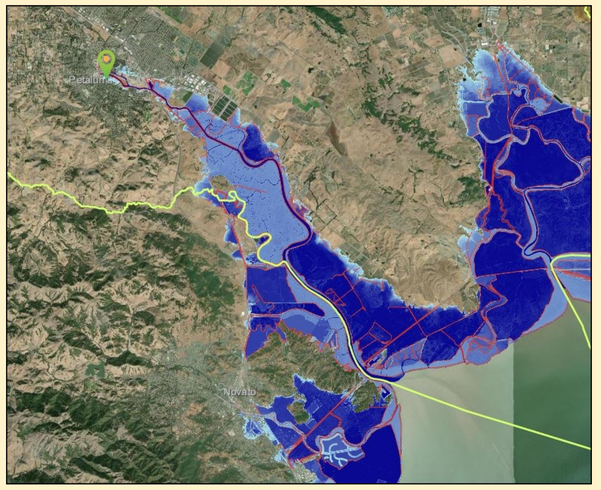
Petaluma has flooded many times. The Petaluma Valley is a relatively flat alluvial plain developed by overlapping and coalescing alluvial fans derived from the erosion of volcanic rocks in the bordering highlands. . Through the years, growth has resulted in encroachment upon many segments of the waterways and floodplains in the urban area. The downtown area flooded many times in the past. Floods in the Petaluma River Basin are normally of short duration, lasting 3 to 4 days, or less. Tributaries of the Petaluma River can begin to rise within hours after a heavy storm event has begun if antecedent soil moisture content is already high. Typically floods occur between December and March. Flooding has taken place in the City, to the extent that at least some street flooding occurs, on average once per year over the past twenty or so years. Recent significant flooding events (meaning street and property flooding) have occurred in Petaluma in 1982, 1983, 1986, 1995, 1996, 1998, and 2005. The largest flood of record in the City of Petaluma occurred from January 3 through 5, 1982 and caused an estimated 28 million dollars in damages. A significant flood event occurred on December 30-31, 2005, over-taxing both piped and open channel systems. Measures were implemented to improve drainage and control the flooding -- flood control projects were constructed, standards were adopted for private development, and floodplain zoning was instituted. In the 1970's the entire eastside, which was an alluvial flood plain and historic wetland, was developed into a suburbia of houses and creeks were confined to nearly straight flood channels from the lower parts of the hills to the river.



SF Bay has lost 80% of its wetlands due to development. **Sea Level Rise** of 3 feet by mid to late century will flood many shoreline areas including the Petaluma Marsh, turning it into a mudflat ecosystem. Higher sea water levels also mean increased flood risk. Many agencies are now working cooperatively to seek regional solutions.



The map at left shows that much of Petaluma is an alluvial plain with highly erodible rocks and soils on the eastside hills. Much of east Petaluma was an historic wetland meadow area. With the suburban development on the east side, many of the creeks that created deltas were channelized into straight flood channels which also increases flood potential downstream.



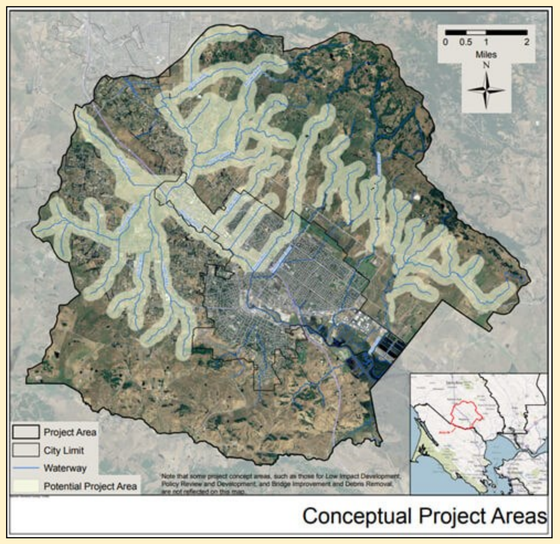
Flooding in Petaluma

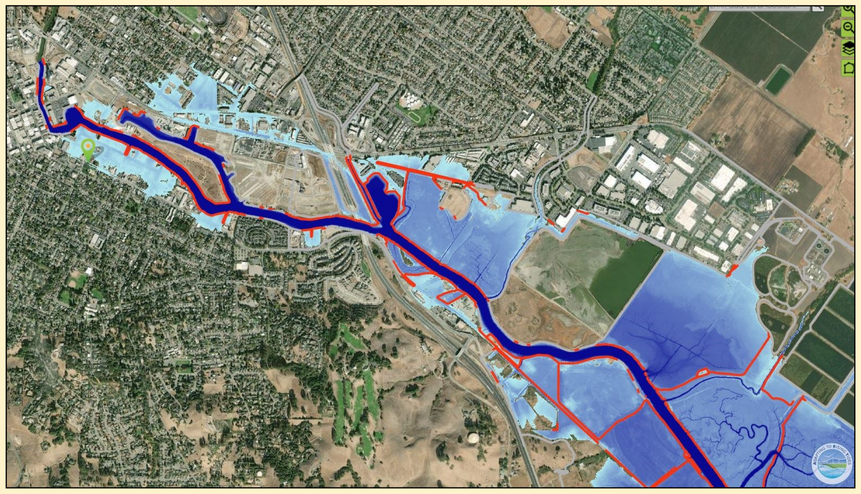
There are many benefits to flood management, especially when projects combine with water catchment, groundwater recharge, habitat restoration, and park site. The chart below shows the synergistic factors that give social, environmental, and economic benefits.

Objectives	Social Benefits			Environmental Benefits			Economic Benefits		
	Public Health & Safety	Property Protection	Public Amenities	Local Env. Enhancement	Regional Env. Enhancement	Global Env. Enhancement	Regulatory Streamlining	Community Viability	Maintenance Efficiency
Flood Hazard Reduction	X	X		X				X	
Groundwater Recharge	X				X	X		X	
Water Quality	X			X	X		X		
Water Supply	X			X	X	X		X	
System Sustainability	X	X		X	X	X	X	X	X
Ecosystem			X	X	X	X		X	
Agricultural Land		X		X	X	X		X	
Undeveloped Land		X	X	X	X	X			
Community Benefits			X	X	X			X	X

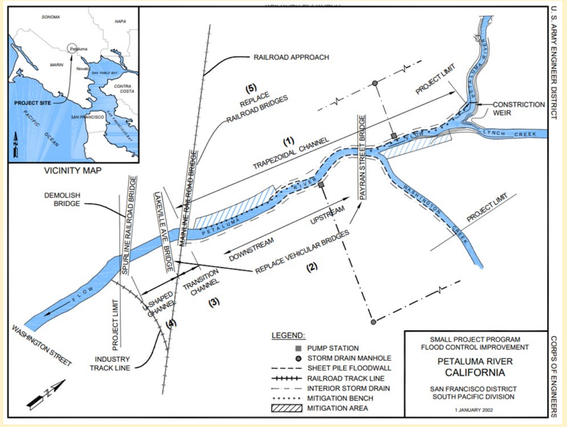
Using Nature Based Solutions

Floods are still coming our way, so we need to take further steps. The city and county are both working on this issue on a continuing effort. The city utilizes a surface water management model (XP-SWMM) as a tool to provide hydrologic and hydraulic solutions for the Petaluma watershed. Restoring wetlands and alluvial plains will help reduce the risk of flooding. Also, reducing sediment outflow to the river with catch basins, vegetation buffers and expanding setbacks will help reduce flood potential. Trees absorb over 30% of initial steady rain and this also reduces erosion and flooding. Many of our creeks can be better managed upstream to reduce flooding downstream. Putting water catchment basins in the upper watershed will help with flooding and also allow more water to seep into groundwater.

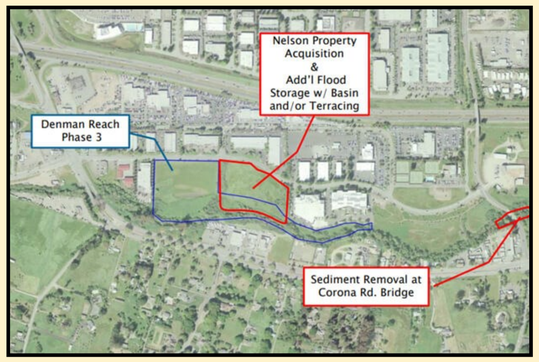




Climate Change should be renamed **Hydrologic Cycle Disruption** since our water cycle in wild fluctuations will be both a cause and result of the warming earth. Ocean water captures and holds a great deal of heat energy and atmospheric water transfers this energy around the globe. Larger storms are occurring more frequently, and their impact is felt across the county. Current and future risk of flooding with rising sea level is illustrated by looking at interactive flood map Adapting to Rising Tides Bay Shoreline Flood Explorer website found online at: https://explorer.adaptingtorisingtides.org/home. The map above right of Petaluma shows water level with 3-foot rise in sea level and 25 year storm, expected by mid-century. The map above center shows similar situation for the marsh. The red lines are dikes that will be overtopped with water filling in areas behind. Many of the agricultural lands near the mouth of the river have subsided (reduced in elevation) and are the most threatened area for flooding. Flooding also depends on the rate of flow out through the river/slough and marsh. Buildup of sediment reduces the size of the channel. Larger storms in future with rising sea level combined with King Tides will only increase flooding potential in the future. The downtown area next to the river is at high risk of future flooding so structures in that area many need to be relocated. Building new housing next to the river also is at high risk of flooding.



A **flood plan** developed for Petaluma over 10 years ago set up criteria to evaluate best investment strategies for flood management actions. Eleven project concepts were identified. Payran-Lakeville Flood Basin Project was a result of this effort. Work on the project began in 1988, following an unusually powerful storm in 1982 that caused $28 million in flood-related damage. A smaller storm in 1986 still caused $1 million in damage, prompting the city to seek federal aid to improve its flood control infrastructure in the area. Spanning north from Lakeville Street, the project included the installation of hundreds of feet of floodwalls, two new emergency pumping stations, replacement of the Payran and Lakeville Street bridges, construction of a new rail bridge, planting of native trees, and reshaping of the channel east to Lynch Creek. Costs were shared between federal and local funds.



Another project, Denman Reach, located on the Petaluma River north of Corona Rd., will provide additional flood protection, enhance riparian habitat, and manage sediment.

Poster created by John Shribbs

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