SFEI WATERSHED SCIENCE ANALYSIS

OF SAN ANTONIO CREEK, SONOMA AND MARIN COUNTIES,

Synopsis of the Draft Report

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Project Description

The San Francisco Estuary Institute (SFEI) conducted a survey of stream bank and bed, physical conditions and sediment supply along 6.6 mi of San Antonio Creek . The analysis was performed for the Southern Sonoma Resource Conservation District (SSCRCD) with funds provided by the US Environmental Protection Agency through CALFED.

The work was constrained by the funding available and by a requirement that it be done in a period of three months

The primary objective of the work was to advance the understanding of watershed processes and the effects of land use practices on mainstem San Antonio Creek since the time of European settlement. We have estimated the time period for landscape response to non-native land uses in the San Antonio watershed to be the last 160 years.

The following factors were measured: length, location, and volume of sediment sources associated with bank and terrace erosion; length, location, condition, and type of bank revetment; location, type and size of culvert outlets and other engineered structures crossing the creek; distribution and percent of particle size classes on the bed including the D50 size class; volume of sediment generated by bed incision; number, volume, cause and spacing of pools greater than 1ft deep; number, spacing, species, and recruitment processes of woody debris. In addition, the amounts of sediment that have been generated by anthropogenic influences versus natural processes have been estimated. Additional objectives included training in field assessment methods for technical staff of the SSCRCD, and graphing of existing US Geological Survey gage data on peak flows.

Data Collection

The mainstem channel of San Antonio Creek is presently about 9.1 mi long upstream of the usual extent of higher high tide, which corresponds to distance station 0.0. Its drainage area upstream of station 0.0 is about 30.8 sq mi. Data on all factors listed above were continuously measured and recorded within our 6.6 mi-long Study Reach, except for two areas. One was a 0.4 mi-long component reach to which access was denied by the landowner. The second area was along the 0.4 mi-long diversion ditch at the downstream end of the Study Reach. Since we did not know the original dimensions of the ditch, we were unable to estimate sediment supply from bank erosion. The Study Reach consists of about 70% of the entire mainstem channel, including its entire downstream portion to the influence of the tides at Petaluma Marsh.

Data Presentation

The data were presented in a variety of graphic and tabular displays. The planform of the channel, the location of distance stations, and the locations of the sub-reaches are shown on the photo maps. The Study Reach was subdivided into 10 component reaches based upon obvious morphological changes. Streamline graphs depict existing conditions along a continuum of the bed and banks of the Study Reach. Discrete volumes of sediment supply from bank erosion, volume of pools, and location of culverts and bridges are noted. Changes in channel parameters are also graphically summarized for each reach, and for the entire Study Reach as a whole. The component reach within the Study Reach for which access was denied is called Gap Reach. It is important to note that the volumes of sediment supply reported in the graphs for San Antonio Creek do not represent the total sediment supply from the mainstem channel as a whole, because 2.5 mi of the upper mainstem channel have not been studied.

Key Findings and Their Importance

Quantitative description and analysis of the physical nature of the channel are essential for locating the places where unwanted or undesirable conditions exist and estimating what measures might be taken to improve them. For example, it is necessary to know the source and magnitude of the sediment supply.

Stream incision and bank erosion have been pervasive along most mainstem channel of the upstream of Guernsey Reach. Yet, some of the most severe bank and bed erosion was observed along the 2.5 mi of the mainstem channel that was reconnoitered but not quantitatively studied. We expect that the highest volumes of sediment supply per linear foot of channel occur along this unquantified portion of the mainstem channel. Before the period of intensive dairying and cattle ranching, a natural laguna or shallow lake existed at the headwaters of San Antonio Creek. This should not be confused with Laguna de San Antonio, which exists to the west at the headwaters of Chileno Creek. Based upon review of historical documents, we expect that the laguna for San Antonio Creek was drained for agricultural purposes sometime between 1860 and 1885. Additional ditching and deepening of existing ditches may have occurred during the early 1950's.

Historical accounts indicate that the mainstem of San Antonio Creek used to be a perennial stream, at least through its lower reaches, and perhaps through a much greater portion of its entire length.

A significant steelhead fishery existed historically, with common sightings of fish until the mid 1900's. According to local residents, steelhead are no longer observed in the creek. This was consistent with our own findings.

Although we did not collect water quality data, Department of Fish and Game reported to us that ammonia levels are high year-round (Mike Rug, personal communication), unlike other streams that have the highest ammonia counts with the first flush of the season.

Ditching and draining of the natural laguna caused a reduction in the level of the water table throughout the broad relatively flat Chileno Valley of San Antonio Creek. This had profound effects upon increasing the magnitude and frequency of peak flows on the mainstem channel. Summer/fall base flows have substantially diminished. Historical accounts suggest that the laguna may have stayed wet year-round. When it was at certain high water levels, it would drain into a small channel at its eastern outlet. Historically the position of the headwaters was down valley of the laguna. Today the headwaters extend through the old Laguna into the hillsides. This is due to ditching.

Increased shear stress on the bed and banks from increased magnitude and frequency of peak flows induced a self-perpetuating cycle of bed incision and bank erosion throughout the mainstem channel during the late 1800s, perhaps until the mid 1900's.

The ditching of tributary channels that were previously disconnected from mainstem San Antonio Creek augmented these effects by increasing the drainage density. We think that most the tributaries that are now ditched to connect to mainstem San Antonio Creek in Chileno Valley did not historically convey their water or sediment directly to the mainstem channel. Instead, their sediment load was deposited as small fans at the base of hillsides, and their water went subsurface, adding to the reportedly high water table of the Valley.

The effects of conversion of native perennial grasses to European annual grasses, combined with the effects of intense cattle grazing (soil compaction, reduced thatch cover generating more runoff, more bare soil generating fine sediment) contributed to increased peak flows and supply of fine sediment.

Because of increased rates of bank erosion and draw down of the adjacent water table, there has been a loss of riparian vegetation along the terrace banks. The loss of root strength along some reaches has greatly accelerated the rate of bank erosion. The channel has had a reduction in sinuosity.

Peak flows may have remained elevated until the mid 1900's, when increases in the number of cattle and stricter regulations on water quality required more diversion and retention of water in small reservoirs throughout the watershed. This contributed to a significant reduction in total flow to the channel. As a result of seepage from these artificial retention basins, base flow may have increased locally, and may have been greater than when the Chileno Valley was initially drained, but it would still be much less than the historical condition that featured the natural laguna. Today, peak flows are probably much higher than they were 160 years ago. Yet, total flow is probably much less due to retention and withdrawal of water from reservoirs. Base flows are slightly higher than they were between 1890's to mid 1950's, but much lower than they were before the onset of non-native land practices.

Prior to the mid 1900's, plowing of fields for agriculture was a common practice leading to highly disturbed and erodable soil surface. Such activities may have substantially increased the amount of fine sediments supplied to the mainstem channel. Plowing for cattle feed has diminished as the water table has dropped and as dependency on imported feed has increased. If local trends in land use conversion from pasture to vineyards occurs in this watershed, we would expect to see more soil disturbance and soils that will be purposely maintained to lack soil cover. These practices will generate more runoff and supply of fine sediments to the mainstem channel.

As an effect of the increased draw down along the entrenched mainstem channel, we suggest that the water table may be lower throughout all the valleys in San Antonio Creek watershed because most of the tributaries are deeply entrenched. Consequently, it takes much more rainfall to saturate the soils and generate runoff throughout the mainstem channel. This, in combination with the retention and consumption of water throughout the watershed, has caused the mainstem channel to change from perennial to intermittent.

San Antonio Creek was diverted during the early 1900's from its natural tidal slough, to the much shorter and smaller Schultz Slough. We will refer to the historic slough as San Antonio Slough, although it is still called San Antonio Creek. This diversion may have been done in the late 1930's (Don Vachini personal communication). From the place of this historical diversion, the present course of San Antonio Creek along Schultz Slough is about 2.9 mi long to the Petaluma River. Its previous course along San Antonio Slough to Petaluma River was about 6.6 mi long. Furthermore, the entrance of Schultz Slough is 5.2 mi upstream on Petaluma Creek than the entrance of San Antonio Slough. This would mean that the base level to which the channel is graded is now much higher than it was historically. Because of this diversion, the entire channel gradient of San Antonio Creek has flattened. The extent of maximum tidal influence has moved nearly a mile downstream from its historical position. Deposition of gravel to sand-sized sediments has caused substantial aggradation of the bed, thereby contributing to further loss of channel capacity in the downstream reaches of San Antonio Creek.

Loss of channel capacity, exacerbated by high tides during peak storm flows and the backwater effects of San Antonio Bridge, have lead to increased flooding along Guernsey and Highway Reaches. Historical accounts from Kay Sweeney confirm the cycle of entrenchment and subsequent aggradation at San Antonio Bridge.

Some of the reaches along San Antonio Creek may be functioning as "losing" reaches rather than "gaining" reaches in terms of total discharge. This is due to the over-widened geometry and extreme aggradation of sediments in the "losing" reaches, and to the overall reduction in height of the water table.

Anthropogenic activities within the watershed have lead to greatly increased rates of sediment production, greatly reduced base flow, and greatly increased peak flows to the channel. Without a complete watershed analysis, we are unable to quantify the percent change, although we expect that it is at far greater than 50% increase in sediment supply and a 50% decrease in water supply.

The very high proportion of fine sediment contained in the bed has been directly increased by land use activities.

Recommendations

The bank and bed conditions of the rest of the mainstem channel of San Antonio Creek should be quantified with the same methodologies that were used in the Study Reach. Tributary channels and hillsides for the entire watershed should also be assessed to develop a sediment budget and to determine changes in drainage density. An historical ecology assessment of the watershed should be developed and documented in a much more rigorous and thorough way. Human history that includes native people to the dairy families is essential to document before the knowledge of the earlier landscape and management practices is lost. This should include an understanding of native land practices and the types of dairy practices that occurred before modern technology. Such a perspective would improve our ability to specify management initiatives and to understand the effects of past and present land uses upon the geomorphic changes that we have reported. The longitudinal profile of the mainstem channel should be surveyed to establish monitoring stations that will show changes in bed incision and/or aggradation in the future. A water budget constructed for the watershed as a whole would help evaluate the potential for restoration. Changes in groundwater could be assessed by interviewing ranchers about their wells. It might include re-establishment of the laguna, realignment of lower San Antonio Creek into its original tidal slough, and reduction in total amount of water withdrawal.

8.7 Review of South Bay General Plans

General plans prepared for cities and counties in the South Bay basins were evaluated to identify goals, objectives or policies that contain groundwater protection strategies. Elaborate strategies have been developed in some cities where groundwater is being used as a primary source of water supply. In other cities, where groundwater use is limited and where water is supplied from sources outside of the South Bay basins, little or no strategies have been developed to protect groundwater resources. The general plans were also reviewed to identify groundwater cleanup strategies where groundwater has already been impacted. Table X summarizes the available contacts and websites for planning departments for cities and counties located in the South Bay. A summary of the specific groundwater protection strategies identified in South Bay general plans is provided in Appendix X.

Twenty-seven cities are located in three counties in the South Bay basins (Figure 1). Copies of available general plan elements that describe water resources and pollution prevention were obtained for each of the cities and counties in the South Bay basins. General plans for Union City and Hillsborough were not available. Groundwater protection strategies are described in various planning elements within the general plans including land use, conservation, natural resources, open space, environmental concerns, environmental management, environmental quality, natural environment, and water resources. The various elements of the general plans were reviewed to answer the following questions:

- Does the general plan identify the city or county's source of water and, if so, is groundwater a key component of the water supply?
- Does the general plan specify groundwater pollution protection strategies?
- Does the general plan specify surface water protection strategies to prevent adverse impact to groundwater?
- Does the general plan specify groundwater cleanup strategies where groundwater has already been impacted?

All cities in the Niles Cone and Santa Clara Valley use groundwater for a portion of their public water supply. Cities where groundwater is a key component of the water supply include: Fremont and Newark Union City (Niles Cone) and Campbell, Cupertino, San Jose, and Santa Clara (Santa Clara Valley). *Los Gatos, Milpitas, Monte Sereno, Morgan Hill, and Sunnyvale?)* As described in previous sections of this report, groundwater is currently not being used for the primary source of water supply in the San Mateo Plain except in East Palo Alto and the East Menlo neighborhood of Menlo Park. The following cities have general plans that describe the source of public water supply, be it groundwater or imported surface water: Fremont and Newark (Niles Cone basin); Campbell, Cupertino, Milpitas, Mountain View, Palo Alto, San Jose, Saratoga, Santa Clara, and Sunnyvale (Santa Clara Valley basin); and Belmont, East Palo Alto, Foster City, Menlo Park, San Carlos, and San Mateo (San Mateo Plain basin).

Results of the general plan review indicate several cities and all three counties in the South Bay basins include groundwater protection strategies in their general plans. The levels of detail within the plans vary considerably. Most cities where groundwater is the primary source of public water supply have general plans that contain detailed groundwater protection strategies. Examples of cities where elaborate groundwater protection strategies have been developed include: Fremont in the Niles Cone and Morgan Hill, San Jose, Santa Clara, and Sunnyvale in Santa Clara County. With the exception of Redwood City, there are no cities in the San Mateo Plain with groundwater protection strategies provided in their general plans. Some cities, such as Los Altos, Los Altos Hills, Los Gatos, Milpitas, Monte Sereno, Saratoga, are "bedroom communities" and are located on the margins of the groundwater basin.

Examples of specific objectives, goals, and policies contained within the general plans that may be protective of groundwater include: coordinate with water agencies to monitor water quality and maintain good water quality; protect recharge areas; prevent groundwater contamination due to impacts from new development; require methods to prevent groundwater pollution; design standards to prevent high water table, saltwater intrusion; prevent subsidence; enforce local codes to prevent contamination; manage storage of hazardous materials; enforce hazardous materials regulations to prevent groundwater pollution; manage reclaimed water to avoid adverse impact to groundwater; identify and seal abandon wells that may act as conduits for groundwater pollution; prevent cross-contamination through sewers, installation of piles, dry wells, and improperly abandoned wells.

Most of the general plans for cities in the South Bay basins do not include specific surface water protection strategies to prevent adverse impact to groundwater. An element of Cupertino's general plan includes a policy to "Retain creek beds, riparian corridors, water courses and associated vegetation in their natural state to protect wildlife habitat and recreation potential and assist groundwater percolation."

The general plans were also reviewed to identify groundwater cleanup strategies where groundwater has already been impacted. Mountain View is the only city that has developed an action to "Provide assistance to State, regional, and federal agencies overseeing cleanup of groundwater contamination in Mountain View."

Summary and Recommendations

City and county general plans provide a range of groundwater protection strategies in the South Bay. Each city and county determines the relative importance of various issues to local planning and decides how they are addressed in the general plan. The source of public water supply for each city is described in most of the general plans where groundwater is being used.

Some cities have extensive and specific discussions in their General Plan (e.g., _________, _________), while other cities are silent on groundwater protection issues (e.g., _________, _________). The correlation (do you mean coordination?) between General Plan discussions and implementation was not fully examined in this review. Moreover, this survey did not include interviews with local planners or review of specific ordinances. The committee's experience is that most cities do not take an active role in groundwater protection. Notable exceptions are the Newark, Fremont, and Union Cities, which require investigation of sealing of vertical conduits a condition of redevelopment permits.

Recommendations:

The Regional Board and local agencies should compile examples of General Plan groundwater protection strategies and ordinances and make these available to local planners. Such information could be communicated in workshops, in mailers, or by posting on the Internet.

City and County planning agencies need better access to information on existing groundwater pollution sites when considering redevelopment projects so that future land uses are compatible with existing cleanup requirements. For example, some South Bay sites are being cleaned up to levels that are protective of industrial uses; however, if local landuse changes, there needs to be a mechanism to revisit cleanup standards.