RECOMMENDED ACTIONS

The first five years of Channelkeeper's Ventura Stream Team water quality monitoring efforts identified a number of water quality impairments, which demonstrate the need for action to address water pollution in the area. Although five years of data are not necessarily conclusive, there are several reasons to implement proactive measures now to reduce pollution in this important watershed.

Stretches of the Ventura River, Canada Larga and San Antonio Creeks are listed as impaired waterbodies on the State's 303(d) List of Water Quality Limited Segments due to contamination from non-point source pollution. Moreover, the river is poised to undergo major restoration in the near future with the removal of the Matilija Dam, which may further impact water quality in the watershed.

The Los Angeles Regional Water Quality Control Board is required to develop Total Maximum Daily Loads (TMDLs) for pollutants of concern in impaired waterbodies, and development of TMDLs for the Ventura River watershed are scheduled for 2008-09. Further, Ventura County is implementing a Storm Water Management Program (required pursuant to the State General Permit for Municipal Separate Storm Sewer Systems), and must demonstrate that the strategies therein are effectively reducing pollution in stormwater and runoff. Channelkeeper's data have been and continue to be used by the County for this purpose, as well as for its efforts to assess the overall health of the watershed and to facilitate watershed planning and restoration.

Continue and expand monitoring: Channelkeeper's data can continue to serve as an important resource for municipalities, regulatory agencies and other stakeholders in evaluating the need for and effectiveness of local water quality protection and restoration efforts. Our data will also provide a useful baseline of water quality conditions prior to the removal of the Matilija Dam. Therefore, Channelkeeper's Ventura Stream Team program should be continued, and should further be expanded to include sampling sites in the estuary and in the surf zone at the mouth of the river.

Conduct creek walks: The Ventura Stream Team data would be even more useful if they were supplemented by additional efforts to pinpoint particular sources of the nutrient and bacterial pollution identified through Channelkeeper's sampling efforts. This could be achieved by conducting creek walks to identify discharge points and discrete sources of runoff that may be contributing polluted water to the creeks, testing the discharged water for pollutants, then consulting the County's land use and storm sewer maps to pinpoint potential sources contributing to the pollution.

Educate property owners and enforce ordinances: Once specific sources are identified, Channelkeeper and/or other environmental groups as well as local regulatory agencies should reach out to owners of properties from which polluted discharges may be originating. The focus of the outreach efforts should be to educate business or property owners on the potential problems posed by their particular discharges, and present solutions and best management practices (BMPs) which different types of business or property owners can implement to prevent pollution in the future. The Ventura County Watershed Protection District already possesses brochures targeting pet and horse owners, gardeners, residents and business owners, as well as specific categories of activities for businesses (such as building and grounds maintenance; building repair, remodeling and construction; vehicle and equipment fueling, repair and cleaning; and waste management and disposal); these should be distributed to business owners or residents that own property from which discharges may be originating. This outreach and education should be followed by targeted inspections and monitoring by relevant RWQCB, County or City agency staff responsible for enforcement of existing water quality protection regulations and ordinances. If such monitoring efforts or inspections identify ongoing pollution problems from particular sources, the appropriate agencies should follow up with enforcement action, such as issuing fines or cease and desist orders, to ensure that discharges cease. In the Ventura River watershed, these education and enforcement efforts should target owners/managers of horse facilities and cattle grazing operations, which Channelkeeper believes contribute significant amounts of nutrients into many of the creeks monitored by Ventura Stream Team.

Monitor compliance with Ojai Valley Sanitary District permit: Regulatory agencies should scrutinize the results of monitoring conducted by the Ojai Valley Sanitary District. The District is required by their National Pollutant Discharge Elimination System (NPDES) permit to conduct regular monitoring of waters receiving the discharge from the Ojai wastewater treatment plant (in this case, the Ventura River). Since the treatment plant is a known source of excessive nutrients on the Ventura River, the monitoring results for these parameters in particular should be tracked closely to ensure that discharge limitations for nutrients, biochemical oxygen demand and suspended solids spelled out in the facility's permit are met. If they are exceeded, the Regional Water Quality Control Board (RWQCB) should take enforcement action to bring the facility back into compliance. If these limitations are exceeded on a regular basis, the RWQCB should tighten the effluent limits for these parameters next time the facility's five-year permit is renewed.

Implement stormwater treatment controls: There are a variety of treatment technologies and methods available for reducing bacteria and other pollutants in creeks and storm drain systems, including active treatment systems, such as ultraviolet (UV) light and ozone treatment systems, and stormwater treatment BMPs, such as vegetated swales, infiltration basins, constructed wetlands, and porous pavement, to name just a few. Priority sites that would benefit from treatment controls should be identified, and local municipalities should allocate funding to implement more of these types of stormwater treatment controls in priority areas throughout the Ventura River watershed.

Encourage installation of low-impact development BMPs: In an effort to reduce the mobilization of pollutants in runoff, urban planners are increasingly looking to the use of structural BMPs such as infiltration practices. One example is the use of porous pavement as opposed to impervious asphalt or concrete. Regulatory agencies should seek to encourage the installation of such BMPs by developing and providing incentives, such as facilitated permitting or cash stipends or rebates, to property owners.

In conclusion, while there are a number of water quality problems throughout the Ventura River watershed, there are also many opportunities to address them. Santa Barbara Channelkeeper is committed to improving water quality throughout the watersheds draining to the Santa Barbara Channel, and looks forward to continued cooperation with government agencies, environmental groups, and the public to achieve this goal.

ENDNOTES

1. The sections on the South Coast and the Ventura River were adapted from Veirs et al. (1998), SWRCB-LA (2002), USACE (2002), USBR (2002) and USDA-FS (2004). A reference list is included at the end of the report. When available, references with web addresses were chosen so documents can be easily accessed for additional information. In addition to these general references, specific citations are used when warranted.
2. Climate data for the Ventura region are available from a number of internet sources: DRI-WRCC, CDEC, CCDA and JISAO. The discussions on hydrology reference the "water-year" instead of using a calendar year. The water-year begins on October 1st and ends the following September 30th, e.g., water-year 1998 began on October 1, 1997, and ended on September 30, 1998. Hydrologists and agencies concerned with water in California use the water-year concept because it better fits the seasonal progression of annual precipitation - rainy to dry, snowfall to snowmelt.
3. Los Angeles is used as the example because its rainfall record goes back much further than any other nearby location.
4. For example, average daily and peak 15-minute flows during a storm on February 12, 1992, were 12,400 and 43,800 cfs, respectively, compared with the 5-10 cfs usually seen at Foster Park.
5. For example, the last three years saw only eleven months of flow at VR04 and VR05, four at VR11 and five at VR12.
6. Mission Creek is used as the example because the Foster Park gauge, the only USGS gauge on the Ventura River, became indefinitely inoperable as of February 2005.
7. By the end of April 2005, the amount of rainfall was 222% of the annual average at Oxnard, 268% at Los Angeles, 204% at Santa Barbara and 239% at Lake Cachuma.
8. US EPA (1997), Deas and Orlob (1999) and Heal the Bay (2003) were used in the preparation of the water quality parameters sections.
9. Other abrupt decreases shown in the figure are probably due to error. In June 2001, very low conductivities were measured at VR01, VR02 and VR03 (Figure 7, upper panel), all Group I sites. However, normal readings were recorded elsewhere by Groups II and III, which clearly indicates a meter malfunction.
10. Milligrams per liter is the weight of oxygen in a liter of water. It is often simpler to think of mg/L as "parts per million." Since a liter of water weighs a million milligrams, 1 mg/L is the same as one part of dissolved oxygen in a million parts of water. Percent saturation is the amount of oxygen dissolved in water relative to the total amount of oxygen that can be held under equilibrium conditions at that temperature.
11. As before, these markers are for steelhead and trout; for warm-water fish, each limit could lowered by 1 mg/L, decreasing them to 7, 5 and 3 mg/L, respectively.
12. In other words, the oxygen excess or deficiency (the meter makes this calculation based on measured temperature and an entered value of the sampling elevation).
13. A percent saturation above 100% simply indicates that water is not at equilibrium but is in the process of releasing oxygen into the atmosphere, just like a glass of recently poured soda sheds an over-saturation of carbon dioxide as streams of bubbles.
14. Three sets of data were combined to make the pH charts: field measurements through June 2003, laboratory measurements made from collected samples from June 2003-March 2005, and finally, field measure-

ments again from April 2005 onward. pH is a difficult measurement to make, even in the laboratory, and the initial portable meters used by Channelkeeper proved unreliable. Newer, higher quality meters are now available and were used beginning with the April 2005 sampling. During the intervening period, laboratory measurements were made with a meter borrowed from the UCSB-LTER program. When looking at Figure 19, more faith should be placed on the 2003-2005 data than on earlier measurements.

15. In this area, water is usually slightly acidic with a pH of 4-5.

16. Ventura waters are high in carbonates with acid neutralizing capacities (ANC), e.g., ANC typically around 4,000 μeq/L.

17. Since it is not regarded as a cold water stream, Canada Larga (VR04) only needs to meet a standard of > 6 mg/L. Sites not shown on Figure 23 (VR09, VR10 and VR11) also underwent pre-dawn sampling on June 2, 2005, and all met the 7 mg/L criterion.

18. There are other ways of expressing chemical concentration, but this is the most common. Again, it is easier to think of mg/L as "parts per million," e.g., 10 mg/L as 10 parts of nitrogen in a million parts of water.

19. The single poor result likely represents a sampling error.

20. Note that we are underestimating the actual situation – phosphate is only part of the total phosphorus concentration in Ventura River samples, with organic phosphorus making up the remainder. Typically phosphate represents approximately 80% of the total phosphorus in our nutrient samples.

21. Sampling rarely takes place on a rainy day because rainy days only occur about 4% of the time; with sampling occurring once a month during the winter, there is only a one in ten chance of encountering rain, or about once every two years.

22. Given that the suggested EPA eutrophication limits are typically measured as total nitrogen and total phosphorus, some explanation of why phosphate was used instead of phosphorus, and nitrate in place of total nitrogen, during the previous discussions is warranted. The University of California, Santa Barbara's Long-Term Ecological Research project (UCSB-LTER) analyzes the Stream Team nutrient samples for Channelkeeper. Nitrate and phosphate (and ammonium) are analyzed as soon as possible (typically within a few days), but total nitrogen and total phosphorus are analyzed months or even a year later (samples undergo initial processing as soon as possible, but are then stored in a preserved condition). Therefore, delay is part of the reason; nitrate and phosphate are used because results are available sooner. Typically, nitrate and phosphate results are available two months after other sampling data, while total nitrogen and phosphorus are 5-10 months further behind.

    Error and imprecision are part of all laboratory analysis; a result is never simply a number, but a number plus or minus some error. Total nitrogen and total phosphorus are analyzed to determine the concentrations of organic nitrogen and organic phosphorus in a sample. The inorganic concentration is simply subtracted from the total – phosphate from total phosphorus, inorganic nitrogen (nitrate + ammonium) from total nitrogen, and what remains is the organic fraction.

    Sometimes analysis error or the precision of the result is such that the inorganic concentration is higher than the total concentration, e.g., a larger number has to be subtracted from a smaller. For example, the total phosphorus concentration may end up being lower than the phosphate in a sample. Obviously, this cannot be true; something either went wrong or the precision of the analysis was not high enough to produce a satisfactory result by subtraction. This happens about 4% of the time with nitrogen (which is acceptable, particularly when concentrations are high), but 50% of the time with phosphorus. The phosphorus results present a real problem, one that the UCSB laboratory has not been able to solve. Something in our local stream water removes phosphorus from solution during the test procedure, and since the total phosphorus results are undependable, phosphate is used instead.

This is not an important distinction. Phosphate makes up a large majority of total phosphorus in the Ventura Stream Team samples, and nitrate is the dominant nitrogen fraction at most sites. Analysis of filtered vs. unfiltered samples to determine nutrient composition is another difference without a distinction. Tests on filtered and unfiltered samples at most of the Ventura Stream Team sampling sites show no statistical difference between these two types of samples. Except for the rare rainy days, Ventura River water is relatively sediment free (see the turbidity results shown in Figures 17 and 18). Summarized results of the overall nutrient analysis (through September 2005) are given in Table 2. The variation of nutrient concentrations and other constituents during storms is not part of the Channel keeper sampling program, nor is it discussed in this report. However, it remains an important topic, since the great majority of the annual load of pollutants flushed into the neighboring ocean occurs during these events. Figure 30, showing variations in concentration during the major storm of 2003 (data from UCSB-LTER), is included to demonstrate what does occur.

23. This ratio, 16 atoms of nitrogen to one atom of phosphorus, is named the "Redfield ratio" after its discoverer (Sterner and Elser, 2002).

24. Redfield ratios are proportions between atoms. Previously, nutrient concentrations were shown in mg/L, a unit based on the weight of nitrogen or phosphorus in water. The µmole, a measure of the number of atoms, is more useful when comparing the proportions of nutrients; 1 mg/L of nitrate as nitrogen is equal to 72 µM, 1 mg/L of phosphate as phosphorus equals 32 µM.

25. A nitrate to phosphate ratio in the thousands indicates the virtual disappearance of phosphate.

26. A possible exception may be greatly increased export during El Niño years when the upwelling and circulatory processes that normally provide a large supply of nitrogen to the Channel are greatly diminished in warmer ocean waters.

27. The following documents were used as references in the preparation of the bacteria section: US EPA, 2002 and 2004; SWRCB, 2003 and 2004; RWQCB-LA, 2001. There are significant differences between EPA indicator bacteria guidelines and current California State regulations, as well as among those of the different Regional Water Quality Control Boards and counties within the state. The regulatory situation is in flux as some of these differences are being ironed out, and thus the narrative on bacteria should be considered a reasonable overview and not taken as definitive.

28. California Public Health requirements for bacteria counts are complicated and vary somewhat by jurisdiction; what follows is simply a broad outline.

29. This average is the "geometric average" or "geomean" - bacteria counts are converted into logarithms, averaged, and the average log value converted back into a regular number. The geomean reduces the influence of very high or low numbers, which might unfairly represent aberrant samples.

30. 235 for beach areas, 500 for occasional recreational use.

31. In other words, as long as less than 10% of the coliforms are of fecal origin.

32. Channelkeeper does not actually test for fecal coliform. Instead, the E. coli values have been multiplied by

1.7 to estimate fecal coliform concentrations (this assumes that a fecal coliform sample would consist of approximately 60% E. coli; this equivalency is the value assumed by most regulatory standards and is a conservative estimate; see also Cude, 2005).

33. It was found that riverbank soil was the principal source of dry weather E. coli in a Florida stream, and that E. coli exhibited a competitive advantage over predators as soils dried (Solo-Gabriele et al., 2000).

34. 8.5 is the LA Regional Water Board's upper limit for pH for surface waters.

35. The following websites were used as references in the preparation of the full-suite sampling section: US EPA, Ground and Drinking Water (http://www.epa.gov/safewater/mcl.html#mcls); US EPA, Pesticides: Health and Safety (http://www.epa.gov/pesticides/cumulative/); Agency for Toxic Substances and Disease Registry (http://www.atsdr.cdc.gov/); Ontario, Ministry of the Environment (http://www.ene.gov.on.ca/cons/); and the International Programme on Chemical Safety – ICHEM (http://www.inchem.org/). The subject of trace contaminants is complicated and the regulatory situation constantly changing. The narrative in this section should be considered simply as an introduction to the subject, and is intended to be neither a complete overview nor definitive in a regulatory sense.