Water Quality Analysis for the South Yuba River
Nevada County, California
Funded through CALFED South Yuba River Recreation Survey
and Yuba River Watershed Health
Improvement and Monitoring Project

July 2000 – May 2002
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Executive Summary
A generalized water quality survey began in July of 2000 and continued monthly until May 2002 on the South Yuba River in Nevada County, California. Designed to determine potential impacts of recreation, historic mining practices and residential development on water quality along the river corridor, the study results describe the river’s existing condition and suggest follow-up actions. The conclusions in this report will be incorporated into a river management plan developed by a consortium of land managers and interested community leaders. In a general sense, the water quality in the South Yuba is satisfactory with the exception of localized areas of sediment loading. Higher temperatures may not be conducive to supporting anadromous fisheries in the summer months. Adverse health effects due to Enterococcus bacteria were not well defined at the time of this report.

A summary of recommendations follows.

Entire South Yuba River

- Elevated summer water temperatures may adversely impact existing or prospective fisheries. A more detailed evaluation of optimum flows and their downstream effects is suggested to determine the most favorable balance between necessary water diversions and minimum flow requirements necessary to support fish populations. Metabolic adaptations to temperature extremes in the existing fish population and surrounding foothill rivers currently supporting anadromous fish should be studied.

- Recreation activities do not adversely impact water quality to any great degree. No increase in sediment or bacteria could be attributed to recreation. It is expected that trails along the river do contribute to increased sediment loads. Water-contact recreation continues to be a potential source of bacterial contamination. However, the validity of using Enterococcus bacteria as an indicator of fecal contamination is currently under discussion.

- An expansion of recreation opportunities will not likely adversely affect fish if use remains concentrated at river crossings.

- Water quality in the South Yuba does not appear to be adversely impacted by recreational dredging. If the current trend continues, it is likely that dredging activities will diminish over time.

- Electrical conductivity is relatively low in the South Yuba River, characteristic of rivers running over granitic substrates. Primary food production may be inhibited by this low conductivity condition.

Upper South Yuba River to Humbug Creek

- River impacts from logging, with particular emphasis on roadway erosion, should be addressed in the management plan. A private timber harvest operation caused an observable
increase in turbidity in the upper reaches of Humbug Creek. The State Water Resources Control Board confirmed that mitigation was necessary to regain water clarity. Land managers should recommend increased enforcement and oversight at harvest operations in the South Yuba and its tributary drainages.

- Nitrate and bacterial concentrations found downstream of Washington were well within regulatory limits. No problem was identified with Washington area homes and their septic tanks along the river.

**Humbug Creek Drainage**

- The entire Humbug Creek drainage needs further site characterization to determine adverse effects of sediment and mercury on the South Yuba. The results confirm that the principal sediment contributor to Humbug Creek is the Malakoff Diggins State Historic Park via Diggins Creek. Low pH in an unnamed tributary of Diggins Creek should also be evaluated. Future studies should examine sediment impacts on fish and other aquatic life as well as mercury biomagnification and methylation. The management plan will need to address potential mitigation measures in this drainage to improve water quality in the South Yuba River watershed.

**Lower South Yuba River below Humbug Creek to Bridgeport**

- Further evaluation of bacterial contamination at Bridgeport in the fall during rainy periods is needed. Land managers may need to work with the boating community to alert and educate this user group about potential health concerns.

- Little Rock Creek could be characteristic of many source waters flowing into the South Yuba in the summer months. Bacteria levels in this creek during the summer months exceeded thresholds for both *Escherichia coli* and *Enterococcus* bacteria. Further studies should include a cumulative evaluation of tributary impacts on the South Yuba with respect to bacteria.

- Sediment caused from human-induced erosion is a problem in the lower watershed. An assessment of potential impairment due to erosion with emphasis on sediment sources above Hoyt Crossing and Edwards Crossing is recommended. Mitigation may need to be discussed during management plan development.

**South Yuba River Tributaries**

- An evaluation of sediment transport and bacteria in the tributaries is recommended. Although not included in this assessment, Scotchman and Spring Creeks have an observable reduction in water clarity during storm events since they drain hydraulic diggins, while Poorman Creek remains clear year-round.
- Concentrations of arsenic and chromium in the tributary drainages studied do not pose a health risk to humans or adversely impact the environment. Tests for mercury were completed. Mercury was not detected in this study.

Background

Building on the existing spirit of cooperation among local, state and federal government agencies and community-based groups working on resource issues in the Yuba River watershed, the South Yuba River Watershed Management Team began the process of developing a plan for the 40 miles of South Yuba River between Spaulding and Englebright reservoirs. Partners include the US Forest Service – Nevada City Ranger District (USFS), the Bureau of Land Management – Folsom Field Office (BLM), California State Parks – Gold Mines Sector and Nevada County Planning Department. The goal is to bring public and private entities together to establish and maintain a healthy watershed for local users and downstream beneficiaries.

In 1999, the South Yuba River was added to the California Wild and Scenic River System. A forty-mile corridor of the South Yuba River from Lang Crossing to Kentucky Creek defines its boundaries. From the confluence of the river with Fall Creek to its confluence with Jefferson Creek below the town of Washington, the river carries a Recreational designation. The remaining sections are designated Scenic. The South Yuba is a tributary to the Sacramento River watershed within the Feather River/Sutter Basin Ecological Zone. It has also been nominated for Federal designation as a Wild and Scenic waterway.

The Yuba River Watershed Health Improvement and Monitoring Project is a component of a river recreation survey. It is designed to examine the river’s baseline condition, identify goals and objectives based on assessment results, and develop a coordinated management, implementation, and monitoring plan to meet watershed health goals and objectives. The phased approach, to be completed over a 5- to 7-year period, leads to a process of adaptive management for the Yuba River – evaluating alternatives to meet objectives and adapting future management actions on both public and private lands based on monitoring.

The South Yuba River currently supports a high level of recreational use. Visitors to the river were thought to have a direct impact on the health of the watershed in terms of sedimentation inputs, human waste disposal and direct contact recreation. Before specific management actions can be taken to address these and other issues, agencies and interested stakeholders needed reliable data upon which to base decisions. This study developed baseline data focused on potential water quality degradation due to recreation.
River Character

In a general sense, the South Yuba River is characteristic of several mid to high elevation rivers in the western Sierra Nevada. In winter, it runs clear and cold with turbidity increasing during storm events at lower elevations from erosion sources; some natural, some human-caused. The spring brings increased flows as the Sierra snowmelt spills over the dam at Lake Spaulding. This time period supports a short boating season, generally falling off by May of each year.

The summer months see a dramatic decrease in flow as waters from Lake Spaulding are directed away from the South Yuba for Central Valley irrigation use and power generation. Minimum flows of five or less cubic feet per second continue to feed the river from Lake Spaulding throughout the summer months. The summer and early fall flows in the South Yuba are principally derived from the river’s many tributaries. Recreationists flock to the major road crossings in the summer when flows are reduced and the warmer water temperatures conducive to enjoying the river resource. Water contact recreation is at its peak during the summer. The first rains in autumn carry the “first flush”. All of the summer season’s terrestrial contamination sources are mobilized by storm events resulting in elevated bacteria levels in portions of the river. Some boating enthusiasts enjoy the river’s flows during late fall and winter months, raising some concern about exposure to unhealthy levels of bacteria.

Project / Task Description

This report provides a generalized assessment of water quality along the South Yuba River. Data was gathered to assess the impacts of recreation use (including historic and recreational mining) on water quality. In the original scope, field sampling was conducted from July 2000 to December 2001 to accumulate data across all seasons and weather conditions. Due to additional funding from another source, a limited sampling program continued through May 2002. All results are included in this report.

This field study was designed to support a future multijurisdictional watershed planning effort. It was designed to address resource issues that are likely to be considered by the planning team. It was designed to provide the data and informational basis for addressing specific planning questions related to water quality. It focused on measuring water quality at recreation and mining sites. A number of residences are located in the South Yuba River corridor in the town of Washington. A cursory analysis of the potential adverse river impact of septic tanks in this area was also conducted.

The Study Objectives:

- Gather baseline water quality data to aid in the development of a comprehensive river management plan along the State Wild and Scenic River corridor.
- Coordinate water quality sampling with existing efforts.
- Determine compliance with regulations and draft guidelines related to recreational activities.

Principal personnel utilized for the study were the Project Manager, Survey Manager, and two to three surveyors. All were Department of Parks and Recreation employees except for the Project Manager. A team of land managers representing BLM, USFS and State Parks met on a routine basis
to provide guidance for the project. Other personnel from associated agencies advised as needed. The Survey Manager coordinated with other monitoring groups to ensure data consistency. The land management team provided technical review of draft and final documents.

The general strategy consisted of upstream and downstream sampling at principal recreation sites along the entire 40 miles of the river corridor (see Sample Locations Map). Principal recreation activity occurs at the five river crossings and day use areas in Washington. Although the South Yuba Trail provides access to remote sections between crossings, use is fairly limited. Samples were also taken upstream and downstream of Washington to determine the community's potential impact. To identify potential problems with historic mining, samples were taken in three tributaries: Humbug, Poorman and Diamond Creeks. These creeks were selected because each represents an aspect of historic mining.

**STUDY AREA SAMPLE LOCATIONS**

Sampling protocols are listed in Appendix 1. Normally, grab samples or measurements were taken from the shoreline at a depth of 6 – 24 inches. All tests were conducted in the field with the exception of bacteria, metals and turbidity. All equipment was calibrated immediately prior to use. Staff attended two intercalibration sessions conducted by the California State Water Resources Control Board to ensure that equipment met quality control guidelines. A Quality Assurance Project Plan (QAPP) developed for the project is included in Appendix 3.
Sampling Process Design

Potential contamination sources evaluated in this study included recreation activities along the length of the river, historic mining and existing homes along the river in Washington. Recreationists are a potential source of bacterial contamination and turbidity. Historic mining causes turbidity and potential metals contamination. Poor sanitation from recreation use throughout the river corridor may contribute to bacteriological problems. Septic systems may contribute bacteria and/or increase nutrient loads. These were the principal sources of potential degradation evaluated in this study. The study’s outcomes will support maintenance of the river’s current water management practices, justify additional research or prompt suggestions for management actions during plan development.

The principal sampling strategy isolated the recreation areas at major road crossings. Samples were taken above and below these areas to determine if a change had occurred there. If there was a difference between upstream and downstream tests, it was likely to be attributed to recreation use. Along Maybert Road, it was necessary to select sample locations to isolate residential structures from the day use and camping sites in Washington. Other uses that affect water quality are the near-river land use of trails, picnicking areas, parking lots and river crossings. If roads, trails and recreation facilities are not constructed with erosion control in mind, increased sediment deposition during the rainy season is likely. This could adversely affect fish life and bottom dwelling biota. Another potential contributor of sediment was examined; the watershed of Humbug Creek located on the north side of the river.

Previous studies indicated a potential for septic tank/leach field systems failure on lands adjacent to the South Fork of the American River during the winter months. When the water levels came up into the leach fields, the resultant untreated wastewater flowed into the river. Thus, the Project Team decided to analyze Escherichia coli (E. coli) and nitrate levels monthly up and down stream from all locations with on-site sewage disposal to determine if these conditions exist in the South Yuba River watershed.

A subcommittee consisting of the Project Manager, Survey Manager and the Project’s Water Quality Consultant identified sampling protocol, locations, parameters and frequencies. They were reviewed and approved by the land management team and are included as Appendix 1.

Two to three staff performed sampling over the course of one to three days. Ideally, the all sampling would occur on the same day subject to staff limitations and weather. Sample protocols outlined in USEPA’s Volunteer Stream Monitoring: A Methods Manual were used to
maintain consistency with other concurrent sampling programs. Cranmer Water Laboratory in Grass Valley also provided input regarding protocols for sampling and analysis. The laboratory is certified by the Department of Health Services' Environmental Laboratory Accreditation Program (ELAP) for bacteriological and metals analyses. There is currently no accreditation process for *Enterococcus* bacteria. However, the laboratory used standard protocols when performing the analysis.

The total number of sample sets taken was approximately 413. The ability to acquire samples at both the upstream and downstream locations at major recreation sites was, at times, limited during the winter’s rain/snow season. Recreational use is minimal during this time. Therefore, acquisition of at least one sample, either upstream or downstream, at each major recreation location was taken. Additionally, access to Sites 26, 31 and 41 require tributary stream or river crossings. As the winter progressed, access at these sites was occasionally limited by high flows. Sites 29 and 46 require a 6-mile hike. They were sampled on days other than standard sampling day(s) and at a lower frequency. However, another sampling effort being conducted monthly by the South Yuba River Citizens’ League (SYRCL) captured some of the needed information on a monthly basis.

**Sampling Methods Requirements**

The procedures for sample collection are outlined in Appendix 1. Samplers were trained in the procedures prior commencing the sampling program. They demonstrated proficiency prior to each monthly sampling event for the first three months. The Survey Manager was responsible for program oversight. She has over three years’ experience performing field assessments of water quality and is familiar with quality assurance procedures.

**Sample Handling and Custody Requirements**

Identification information for each sample was recorded on the field data sheets (see Appendix 4) at the time of collection. Samples were labeled with the sample location, sample number, time of collection, sampler’s name, and method used to preserve sample (if any).

The on-site water quality monitoring tests did not require specific custody procedures since they were conducted immediately onsite by the same person who performs the sampling. Samples not analyzed in the field were sent to a certified laboratory immediately following the fieldwork. Appropriate chain of custody requirements were adhered to. These procedures are described in Appendix 1.

Samples were kept cool prior to same-day delivery to the laboratory. A chain of custody form was used to track the samples from the field to the lab. This form identifies the water body name, sample
location, sample number, date and time of collection, sampler's name, and method used to preserve sample (if any). It also indicates the date and time of transfer, and the name and signature of the sampler and the sample recipient. When the lab performed quality control checks, their samples were processed under their chain of custody procedures with their labels and documentation procedures. Bacteriological samples were immediately incubated upon delivery to the lab. Metals' samples were fixed with nitric acid until analysis was performed.

**Analytical Methods and Equipment**

Water chemistry was monitored using protocols outlined in the Volunteer Stream Monitoring: A Methods Manual\(^1\). These methods were selected to be consistent with similar studies conducted concurrently on the South Yuba River by the South Yuba River Citizens' League (SYRCL).

Standard field equipment was used for water quality analysis.

**Table 1: List of Water Quality Characteristics and Analytical Methods**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method</th>
<th>Modification</th>
<th>Reference (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Thermometric</td>
<td>Alcohol-filled thermometer marked in 2°F increments</td>
<td>2550 B.</td>
</tr>
<tr>
<td>pH</td>
<td>Electrometric</td>
<td>none</td>
<td>4500-H B.</td>
</tr>
<tr>
<td>Conductivity</td>
<td>Electrometric</td>
<td>none</td>
<td>2520 B.</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Nephelometric</td>
<td>none</td>
<td>None</td>
</tr>
<tr>
<td>Nitrate</td>
<td>Cadmium Reduction</td>
<td>prepackaged reagents, colorimeter or spectrophotometer</td>
<td>4500 – NO(_3) E.</td>
</tr>
<tr>
<td>Chromium, Arsenic and Mercury</td>
<td>EPA 200.9 for arsenic and chromium, SM(18)3112(B) for mercury.</td>
<td>Nitric acid fixation</td>
<td>None</td>
</tr>
<tr>
<td>Total Coliform Bacteria</td>
<td>Colilert 18 hour</td>
<td>none</td>
<td>9223</td>
</tr>
<tr>
<td>E. coli Bacteria</td>
<td>Colilert 18 hour</td>
<td>none</td>
<td>9223</td>
</tr>
<tr>
<td>Enterococcus Bacteria</td>
<td>Enterolert 24 hour</td>
<td>none</td>
<td>IDEXX Corp.</td>
</tr>
</tbody>
</table>


\(^1\) United States Environmental Protection Agency, Office of Water, 4503F EPA 841-B-97-003, November 1997
Equipment Used

- **Temperature**: Enviro-safe Pocket Thermometer (Accuracy: 1 scale division) and Oakton Multi-meter (Range: 0.0 to 100.0 °C; Accuracy: +/- 0.5 °C)
- **Turbidity**: Hanna Turbidity meter (Range 0.00 – 1000 NTU; Accuracy: +/- 5%)
- **pH**: Oakton Multi-meter (Range: 0.00 – 14.00 pH; Accuracy: +/- 0.01 pH)
- **Electroconductivity**: Oakton Multi-meter (Range: 0 μS – 19.99 μS; Accuracy: +/- 1% full scale)
- **E. coli bacteria**: 100 ml sterilized plastic bottles containers acquired from lab; analysis performed in the laboratory by IDEXX Colilert Method 9223
- **Enterococcus bacteria**: 100 ml sterilized plastic bottles containers acquired from lab; analysis performed in the laboratory by IDEXX Enterolert Method
- **LaMotte Nitrate/Nitrogen Test Kit** – Range 0 – 15 ppm
- **Metals**: Sterilized 16 oz plastic bottles acquired from lab; analysis performed in the laboratory using EPA 200.9 for arsenic and chromium, SM(18)3112(B) for mercury.

Results

The Water Quality Control Plan (Basin Plan), is an outline of regulatory limits developed to achieve water quality goals published by the California Regional Water Quality Control Board. It was used as the primary basis for determining compliance with water quality standards. There are no regulatory thresholds for temperature in fresh water systems. Water temperatures are discussed below in context of threats to anadromous fish. Raw data is presented in Appendix 2.

Limitations

Field test equipment used for measuring pH and conductivity during the months of July – September 2000 gave false readings and was replaced. In July 2000, Samples analyzed for **Enterococcus** bacteria were incubated at an incorrect temperature. This data was also discarded and not used in the analysis.

pH

pH is a measure of the concentration of hydrogen ions in water. It determines the solubility and biological availability of nutrients accessible to aquatic life. For this constituent, samples were taken monthly at most locations from October 2000 to May 2002. The acceptable range of pH as outlined in the Basin Plan ranges between 6.5 to 8.5. Field sampling results indicated that pH is within limits of acceptability over the entire river corridor with few exceptions. In general terms, this pH will facilitate a healthy aquatic environment.

Exceptions are outlined below in Table 2. If a 95% confidence interval is applied, most readings fall inside the limits with two exceptions. Sites 34, Keleber UP, and 43, an unnamed tributary of Diggins Creek, exceed the limit on one occasion each. All other readings at these sites, with the exception of Site 43, were within range. Site 43, a site draining from historic diggins, may need further evaluation. Its pH in November 2000 was 6.81.
Table 2: pH readings exceeding Basin Plan limits

<table>
<thead>
<tr>
<th>Site</th>
<th>Date</th>
<th>95% Interval</th>
<th>Result (pH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 – Purdon Crossing Downstream</td>
<td>5/31/01</td>
<td>8.20 &lt;x&lt; 9.06</td>
<td>8.63</td>
</tr>
<tr>
<td>25 – Purdon Crossing Upstream</td>
<td>8/30/01</td>
<td>8.18 &lt;x&lt;9.04</td>
<td>8.61</td>
</tr>
<tr>
<td>26 – Edwards Crossing Downstream</td>
<td>5/30/01</td>
<td>6.00 &lt;x&lt; 6.64</td>
<td>6.32</td>
</tr>
<tr>
<td>27 – Edwards Crossing Upstream</td>
<td>8/30/01</td>
<td>8.21 &lt;x&lt; 9.07</td>
<td>8.64</td>
</tr>
<tr>
<td>34 – Keleher Upstream</td>
<td>1/3/01</td>
<td>9.19 &lt;x&lt; 10.15</td>
<td>9.67</td>
</tr>
<tr>
<td>37 – Lang Crossing Upstream</td>
<td>2/2/01</td>
<td>8.21 &lt;x&lt; 9.07</td>
<td>8.64</td>
</tr>
<tr>
<td>43 – Unnamed tributary to Diggins Creek</td>
<td>1/11/01</td>
<td>5.80 &lt;x&lt; 6.41</td>
<td>6.1</td>
</tr>
</tbody>
</table>

Escherichia coli

*Escherichia coli* (E. coli) is bacteria used as an indicator of fecal contamination in surface and domestic water sources. A reading of 235 Most Probable Number per 100-milliliter sample (MPN) is the maximum level recommended for recreational beaches by the California Department of Health Services.\(^2\) Throughout the study period, *E. coli* remained well below this guideline except at Little Rock Creek and Bridgeport. Table 3 outlines results determined to exceed safe levels. Little Rock Creek is a minor tributary of the South Yuba. In summer months, it turns into more of a seep than a creek. Samples free of sediment were difficult to obtain during this time of the year. In December, no explanation is offered as to why bacteria counts in Little Rock Creek were high. The remainder of the samples was less than 10 MPN. This small tributary could be characteristic of many source waters flowing into the South Yuba in the summer months. Further studies should include a composite evaluation of their overall impact on the South Yuba.

Samples taken at Bridgeport downstream of the covered bridge in late October and early November 2001 indicated high bacteria levels. Sampling occurred in the rains considered “the first flush”. There may be a concern if water contact recreation were to occur. Generally, air temperatures drop and the river becomes inhospitable to most users in October each year. In this case, the Survey Manager notified the Nevada County Environmental Health Department of the initial and subsequent findings of bacterial contamination. At that time, it was determined no action would be taken to issue health advisories. Samples taken at eight other sites on October 31 did not exhibit actionable levels. Sample results from October 2000 were well below 50 MPN. A sample was taken on December 3rd. The result was 116.9 MPN, well below the threshold. These results may justify further evaluation of bacterial contamination at Bridgeport in the fall during rainy periods. Land managers may need to work with the boating community to alert and educate this user group about potential health concerns.

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Table 3: *E. coli* readings exceeding Basin Plan standard

<table>
<thead>
<tr>
<th>Site</th>
<th>Date</th>
<th>Result (MPN per 100 ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 - Bridgeport Downstream</td>
<td>10/31/01</td>
<td>770.1</td>
</tr>
<tr>
<td>19 - Bridgeport Downstream</td>
<td>11/6/01</td>
<td>933</td>
</tr>
<tr>
<td>23 - Little Rock Creek</td>
<td>8/2/01</td>
<td>345</td>
</tr>
<tr>
<td>23 - Little Rock Creek</td>
<td>8/14/01</td>
<td>387</td>
</tr>
<tr>
<td>23 - Little Rock Creek</td>
<td>12/28/01</td>
<td>1203?</td>
</tr>
</tbody>
</table>

*Enterococcus* Bacteria

Presence of *Enterococcus* bacteria is also used as a potential indicator of fecal contamination. A water quality consultant and the project team decided to sample these bacteria on a quarterly basis. It is thought to be longer lived in surface waters than *E. coli*. The US Environmental Protection Agency is investigating the possibility of officially accepting it as an indicator to be used either in place of or in conjunction with *E. coli*. The California Department of Health Services published a draft guideline for *Enterococcus* levels in fresh water.

Sampling for *Enterococcus* began in July 2000 (Table 4). The first analyses had to be deleted due to a laboratory error. The second sampling occurred in October 2000. Throughout the fall, winter and spring seasons of 2000/2001, *Enterococcus* levels were negligible. In June 2001, levels began to rise at two locations, Site 25: Purdon Crossing upstream and Site 23: Little Rock Creek. The Department of Health Services' Draft Guidance for Fresh Water Beaches recommends a threshold of 61 MPN. These sites showed an *Enterococcus* result of 111.2 and 225.4 respectively. The Nevada County Environmental Health Department was notified. They subsequently organized a task force to determine the potential threat to public health, the source of the contamination and potential remedies.

Table 4: *Enterococcus* Results from Enterolert Tests (MPN per 100 ml)

| Site                                | Sep-00 | Dec-00 | Mar-01 | Jun-01 | Aug-01 | Sep-01 | Oct-01 | Nov-01 | Dec-01 | Jan-02 | Feb-02 | Mar-02 | Apr-02 | May-02 |
|-------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Bridgeport Downstream               | 7.7    | 1.0    | 2.0    | 12.1   | 64.8   | 22.9   | 660.4  | 184.2  | 65.3   | 1.0    | 1.0    | 13.2   | 1.0    | 121.1  |
| Bridgeport Upstream                 | 2.0    | 1.0    | 1.0    | 15.5   | 43.9   | 16.1   |        |        |        |        |        |        |        |        |
| Jones Bar                           | 1.0    | 0.3    | 2.0    | 26.4   | 9.6    | 15.7   |        |        |        |        |        |        |        |        |
| Hoyt Crossing Upstream              | 5.2    | 1.0    | 32.0   | 15.5   | 13.1   | 123.6  | 63.3   | 4.1    | 7.4    | 4.1    | 1.0    | 64     |        |        |
| Little Rock Creek                   | 1.0    | 2.0    | 111.2  | 186.3  | 386.8  | 191.8  | 29.2   | 11.7   | 1.0    | 2.0    | 4.3    | 1.0    | 22.8   |        |
| Purdon Crossing Downstream          | 2.0    | 1.0    | 1.0    | 25.3   | 866.4  | 9.5    |        |        |        |        |        |        |        |        |
| Purdon Crossing Upstream            | 7.4    | 1.0    | 9.1    | 225.4  | 92.8   | 52.0   | 124.1  | 73.8   | 13.0   | 1.0    | 1.0    | 40.2   |        |        |
| Edwards Crossing Downstream         | 3.1    | 1.0    | 1.0    | 6.3    | 14.6   | 9.7    | 48     | 22.6   | 1.0    | 1.0    | 1.0    | 75.2   |        |        |
| Edwards Crossing Upstream           | 2.0    | 1.0    | 1.0    | 25.3   | 133.3  | 10.9   |        |        |        |        |        |        |        |        |
| Poorman Creek                       | 1.0    | 4.1    | 38.3   | 27.5   |        |        |        |        |        |        |        |        |        |        |
| South Yuba Upstream from Poorman    | 12.1   | 1.0    | 1.0    | 5.2    | 12.2   | 12.0   | 110.0  | 1.0    | 1.0    | 1.0    | 1.0    | 1.0    | 9.7    |        |
| Washington Section 9                | 1.0    | 1.0    | 1.0    | 50.4   | 8.4    |        |        |        |        |        |        |        |        |        |
| Keeler Downstream                   | 1.0    | 1.0    | 2.0    | 25.9   | 7.4    | 31.1   | 1.0    | 1.0    | 2.0    | 1.0    | 4.0    | 3.0   |        | 3.1    |
| Keeler Upstream                     | 1.0    | 1.0    | 1.0    | 44.8   | 18.5   |        |        |        |        |        |        |        |        |        |
| Goldert Quartz Downstream           | 1.0    | 1.0    | 3.1    | 207.6  | 2547   | 58.8   | 1.0    | 1.0    | 1.0    | 1.0    | 1.0    | 1.0    | 4.1    |        |
A public health threat was determined to exist. A health advisory was issued by the Nevada County Environmental Health Department on August 1, 2001, informing the visitors that *Enterococcus* levels had exceeded the recommended threshold in waters at China Dam, near Purdon Crossing. As the number of samples taken to characterize the source and extent of the problem increased during July and August of 2001, users were advised to stay out of increasingly longer reaches of the river. By the end of August, the health advisory covered nearly the entire lower watershed including the Golden Quartz Day Use Area located above the town of Washington. This advisory persisted until September 28, 2001.

During that time, many agencies and organizations joined in the effort to discover the source and extent of the problem. A report of the incident was generated. It's author examined all of the sample results and the potential implications. The contamination could have come from a variety of sources. Human fecal contamination was considered a possibility. The raw sewage from a population of 900 people would be needed to generate the levels of *Enterococcus* seen in the river, an unlikely scenario. Therefore, recreation activity is not the likely cause. Another potential source was wildlife. Over 8000 ducks eliminating waste on the river daily would be required to raise the bacteria levels to those detected in the analyses. The South Yuba does support small numbers of a variety of birds. However, they are spread out along the entire 40-mile corridor and do not congregate in any one area. Other wildlife sources are thought too small to be a major contributor of bacteria.

The multi-agency task force concluded the initial investigation with more questions than answers. One of the concerns was potential sediment or algal interference with the test method, Enterolert. EPA has not approved the Enterolert test method. However, other testing methods (Membrane Filtration and Multiple Tube Fermentation) are approved methods and those tests verified that *Enterococcus* bacterium was indeed present in the samples. Further work was suggested in the report. The summer ended, the algae diminished and *Enterococcus* levels dropped off before further analysis could be performed. In May 2002, elevated levels showing up at Bridgeport evidenced the return of the past summer’s experience.

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3 South Yuba River Enterococci Studies, South Yuba River Citizens’ League, October 2001
The Nevada County Environmental Health Department also sampled Lake Vera and Rock Creek, a South Yuba tributary that drains Lake Vera. Results from these tests were below published levels with the exception of Rock Creek just below the Lake Vera dam. The result was 96 MPN. Because the results were not validated with supplemental sampling events, no action was taken to further investigate this source of contamination.

Total Coliform Bacteria

Coliform bacteria are found everywhere in nature. Because of this fact, total coliform tests are not often used as an indicator of microbiological contamination for recreational waters. The Basin Plan does not have a threshold for this factor. The Department of Health Services' Draft Guidance for Fresh Water Beaches suggests a limit of 10,000 MPN per 100 ml for a single sample value. The Colilert results exceeded the test threshold of 2419.2 MPN per 100 ml on 21 occasions over the course of the study. It was first overrange on August 30, 2000. Subsequent samples were diluted 1:100 to determine how far overrange the results were. The maximum result was 1580 MPN per 100 ml. Though the sample results were overrange, it appears unlikely that any of the results will exceed 10,000 MPN per 100 ml in any given sample.

Temperature

There are no temperature standards for the South Yuba River. Previous studies indicate that elevated temperatures were found to adversely affect the existing fishery. Lethal limits for anadromous fish vary, but average 23.8 degrees Celsius. Appendix 5 lists maximum temperature tolerances for steelhead trout and salmonids from various sources. Fish exhibit respiratory distress, metabolic dysfunction and are increasingly prone to disease in waters that exceed optimal temperatures for extended periods of time. On the other hand, fish also exhibit some adaptation to localized environments. Adaptation has not been studied specifically on the South Yuba. It is only assumed from studies on other rivers.

Temperature readings were taken at a depth ranging from 12 to 24 inches. It is likely that fish would take refuge in deeper, cooler pools in the summer months when daytime temperatures become stressful. The temperature ceiling described was exceeded in the lower South Yuba watershed at locations described in Table 5.

Table 5: Temperatures in the Lower Watershed

<table>
<thead>
<tr>
<th>Locations exceeding 23.8°C in May 2001</th>
<th>Locations exceeding 23.8°C in June 2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridgeport</td>
<td>Hoyt Crossing</td>
</tr>
<tr>
<td>Jones Bar</td>
<td>Jones Bar</td>
</tr>
<tr>
<td>Hoyt Crossing</td>
<td>Purdon Crossing</td>
</tr>
<tr>
<td>Purdon Crossing</td>
<td>Locations exceeding 23.8°C in July 2001</td>
</tr>
<tr>
<td>Edwards Crossing</td>
<td>Edwards Crossing</td>
</tr>
</tbody>
</table>

4 Pers. Communication, Randy Bailey, Fisheries Biologist, Bailey and Associates
Some of the temperature readings were taken early in the morning. Temperature readings from another element of the recreation survey indicate that the entire lower watershed has the potential to exceed 23.8°C in the summer months.

Temperatures become elevated from two principal sources, solar radiation and thermal radiation from submerged bedrock or shallow runs over coarse substrates. Planting overstory vegetation to cool water would likely be unsuccessful due to the scouring effects of winter flows on the river corridor. Increasing water discharge from Lake Spaulding may reduce temperatures in the upper reaches. However, in the lower section of the river, solar and thermal radiation may offset attempts at temperature reduction due to increased flows. A more detailed evaluation of optimum flows and their downstream effects would be necessary to balance between necessary water diversions and minimum flow requirements of anadromous fish populations and their supporting environment.

These results support the need for further studies to determine the extent of potential habitats available for anadromous fish in the South Yuba. Local adaptation thresholds of native cold water fishes may be extrapolated to steelhead and salmon. Studies of local adaptation in similar Sierra foothill streams currently supporting anadromous fisheries should also be included in the habitat suitability studies.

Recreationist activity is also affected by temperature. Visitors either wade or swim based on ambient air and water temperatures. Optimum water temperatures for water recreation are inhospitable for fish. As temperatures rise, water contact recreation increases. Deep pools are attractions to both humans and fish. If fish do not have adequate refuge in cooler pools, there may be a resource conflict at these locations in the summer months. Still, recreation use is concentrated at the main crossings. There are ample pool habitats for fish between the crossings undisturbed by human use. It is not anticipated that an increase in recreation opportunities will adversely affect fish as long as use remains concentrated at the river crossings.

Turbidity

Turbidity is a measure of water clarity. High concentrations of particulate matter, both organic and inorganic, can affect water quality. A turbidity value of 1 Nephelometric Turbidity Unit (NTU) is comparable to a clear mountain stream. A value of 10 NTU is comparable to the Mississippi River. The term “nephelometric” refers to the way an instrument estimates how light is scattered by particulate matter in a sample.

Turbid waters can adversely affect fish as indicated in Figure 1. Just as humans avoid breathing dust, cold water fish avoid turbid environments. Aquatic plants and bottom dwelling insects covered by sediments experience similar problems as terrestrial plants and insects covered by dust. Photosynthetic and respiratory processes are inhibited. Pollutant-tolerant plants and animals proliferate and compete with more sensitive species, further degrading habitat quality.

Turbidity can also degrade environments for miles downstream as solid material settles out; filling up reservoirs in the larger perspective, filling in interstitial spaces between gravels on the
smaller scale. Mercury, a particular concern in methylated form, may be transported downstream exposing aquatic flora and fauna to its detrimental effects.

Figure 1:

RELATIONAL TRENDS OF FRESH WATER FISH ACTIVITY TO TURBIDITY VALUES AND TIME

In general terms, the data support the conclusion that the South Yuba is a clear running river in the upper reaches. Observed erosion and tributary influences affecting water clarity do not arise until approximately halfway down the watershed at Humbug Creek. Humbug Creek contributes suspended solids during storm events at its confluence with the South Yuba. This is derived from rainfall-induced erosion in historic hydraulic diggins causing highly colloidal clays to enter its tributary, Diggins Creek. These suspended clay particles are carried to the South Yuba when Humbug and Diggins Creeks merge and are visibly noticeable for some distance downstream of the Humbug/South Yuba confluence. The South Yuba corridor is littered with “diggins” from historic hydraulic mining. These areas contribute unmeasured sediment into the river. Humbug Creek is the most notable and well studied.

Humbug Creek is perceived by the community as a major source of sediment in the South Yuba River. Yet, at its headwaters, the creek has good water clarity. Only at the confluence with Diggins Creek, the main drainage from Malakoff Diggins State Historic Park, does sediment become a significant concern. On a stormy day in April of 2001, samples were taken at five locations in the Humbug Creek drainage. The results are listed below.
Table 6: Turbidity Readings in the Humbug Creek Drainage (NTU)

<table>
<thead>
<tr>
<th>Site</th>
<th>Date</th>
<th>Result (NTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>29 - S. Yuba UP from Humbug</td>
<td>4/20/01</td>
<td>4.90</td>
</tr>
<tr>
<td>45 - Humbug Cr above Diggins Confluence</td>
<td>4/20/01</td>
<td>5.57</td>
</tr>
<tr>
<td>46 - S. Yuba DN Humbug</td>
<td>4/20/01</td>
<td>24.51</td>
</tr>
<tr>
<td>28 - Humbug Ck; DN of Diggins</td>
<td>4/20/01</td>
<td>308</td>
</tr>
<tr>
<td>42 - Diggins Creek at Hiller Tunnel</td>
<td>4/20/01</td>
<td>573</td>
</tr>
</tbody>
</table>

The results confirm that the principal sediment contributor to Humbug Creek is Diggins Creek. An unnamed tributary of Diggins Creek, draining a second hydraulic diggins, also contributes sediment to Diggins Creek. On November 24, 2001, a sample result from Humbug Creek below the Diggins Creek confluence was greater than 1000 NTU. Without intervention to stabilize the cliffs in Malakoff Diggins and perhaps surrounding historical diggins, sediment loading will continue for many years to come. Current and future studies will examine the potential threat to fish and other aquatic life in and around this creek. The management plan will need to address potential mitigation measures in this drainage to improve water quality in the South Yuba River watershed.

Timber harvest operations also adversely affected water clarity during the study period. In January of 2002, a timber operation caused increased turbidity in the upper reaches of Humbug Creek, a section with no prior problems. Erosion control measures were necessary to remedy the impact on the creek. A similar timber harvest is scheduled to commence in the same general vicinity in the fall of 2002. River impacts from forest operations should be addressed in the management plan.

Other human activities such as road construction, land clearing and residential development add an unknown amount of sediment into the South Yuba. It appears that the lower portions of the watershed experience a more significant impact from these activities. The upper watershed remains largely unaffected by human-caused sediment loading except for specific instances of development or timber harvest operations. This is principally due to the relative inaccessibility of the river canyon in many of its upper sections.
The Basin Plan requires that point source dischargers maintain discharges so that "waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses". There is no clear standard for non-point source discharges. However, if applying the point source discharge standard, increases shall not exceed 1 NTU where natural turbidity ranges between 1 and 5 NTU. The "natural" turbidity of the South Yuba averages below 5 NTU. Therefore, results of 6 NTU or more indicate that further investigation of the source(s) is justified and potential mitigation measures should be developed in the management plan.

Three sampling events suggest that turbidity may be a problem in the lower reaches of the watershed. Whether the causative factor is derived from human or natural forces is outside the scope of this study. At times, tests in the Humbug Creek outflow and the lower watershed indicate that natural turbidity thresholds have been exceeded during storm events. At other times, tests are well below 5 NTU.

On February 27, 2001, turbidity was measured from Edwards Crossing to Bridgeport. Results are outlined below.

Table 7: Turbidity in the Lower Watershed in February 2001

<table>
<thead>
<tr>
<th>2/27/01</th>
<th>Result (NTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td></td>
</tr>
<tr>
<td>19 – Bridgeport DN</td>
<td>6.1</td>
</tr>
<tr>
<td>20 – Bridgeport UP</td>
<td>2.96</td>
</tr>
<tr>
<td>21 – Jones Bar</td>
<td>10.27</td>
</tr>
<tr>
<td>22 – Hoyt Crossing</td>
<td>15.47</td>
</tr>
<tr>
<td>24 – Purdon Crossing DN</td>
<td>0.27</td>
</tr>
<tr>
<td>25 – Purdon Crossing UP</td>
<td>0.00</td>
</tr>
<tr>
<td>26 – Edwards Crossing DN</td>
<td>0.00</td>
</tr>
<tr>
<td>27 – Edwards Crossing UP</td>
<td>0.00</td>
</tr>
</tbody>
</table>

A year and a month later, in March 2002, turbidity in the lower watershed was again high. The samples below were taken immediately following a rain event. Samples taken the following day in the upper watershed were all less than 2 MPN.

Table 8: Turbidity in the Lower Watershed in March 2002

<table>
<thead>
<tr>
<th>3/25/02</th>
<th>Result (NTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td></td>
</tr>
<tr>
<td>19 – Bridgeport DN</td>
<td>20.08</td>
</tr>
<tr>
<td>22 – Hoyt Crossing</td>
<td>17.36</td>
</tr>
<tr>
<td>25 – Purdon Crossing UP</td>
<td>12.69</td>
</tr>
<tr>
<td>26 – Edwards Crossing – DN</td>
<td>6.75</td>
</tr>
<tr>
<td>31, 35, 37</td>
<td>&lt; 2</td>
</tr>
</tbody>
</table>

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6 Personal Communication, Lori Webber, RWQCB
On October 31, 2001, the first major storm event of the season occurred. Turbidity was measured throughout the study area from Lang Crossing to Bridgeport. Though the upper watershed’s clarity was demonstrated, turbidity again increased at Hoyt Crossing and continued to Bridgeport.

Table 9: Turbidity in the Watershed Continuum

<table>
<thead>
<tr>
<th>Date</th>
<th>Site</th>
<th>Result (NTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/31/01</td>
<td>19 – Bridgeport</td>
<td>7.64</td>
</tr>
<tr>
<td></td>
<td>22 – Hoyt Crossing</td>
<td>7.27</td>
</tr>
<tr>
<td></td>
<td>25 – Purdon Crossing UP</td>
<td>1.25</td>
</tr>
<tr>
<td></td>
<td>26 – Edward Crossing DN</td>
<td>0.92</td>
</tr>
<tr>
<td></td>
<td>31 – S. Yuba UP Poorman Cr</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>33 – Keleher DN</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>35 – Golden Quartz DN</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>37 – Lang Crossing UP</td>
<td>0.00</td>
</tr>
</tbody>
</table>

On November 30, 2001, turbidity at Edwards Crossing was very high relative to the upper watershed. It had rained the previous day.

Table 10: Turbidity in the Lower Watershed in November 2001

<table>
<thead>
<tr>
<th>Date</th>
<th>Site</th>
<th>Result (NTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/30/01</td>
<td>26 – Edward Crossing DN</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>31 – S. Yuba UP Poorman Cr</td>
<td>1.01</td>
</tr>
<tr>
<td></td>
<td>33 – Keleher DN</td>
<td>1.56</td>
</tr>
<tr>
<td></td>
<td>35 – Golden Quartz DN</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>37 – Lang Crossing UP</td>
<td>0.95</td>
</tr>
</tbody>
</table>

It is difficult to discern whether this is a common occurrence or a single incident. Further studies are recommended to determine the source(s) of suspended solids coming from above Hoyt Crossing to Bridgeport and at Edwards Crossing. Detailed studies of sediment loading in the lower reaches of the river are warranted.

Water clarity does not appear to be influenced by recreational use. As stated above, the study area above Humbug Creek did not show elevated turbidity levels at any time. In the town of Washington and along Maybert Road, there seemed to be little change in turbidity between upstream and downstream sample results. In many cases, the upstream values were higher than those downstream in summer months. Below Humbug Creek, recreation use seemed to have little impact relative to the measurements taken during the rainy season.

Recreational dredging is claimed to increase suspended sediment in the river. Though this survey did not specifically analyze increased turbidity due to dredging operations, some observations were made. A river survey from Washington at Poorman Creek to North Canyon Creek was conducted on Labor Day weekend of 2001. Eight to ten dredges were observed along
the route; some attended, some not. A small number of those dredges were in operation during the survey. Suspended sediments downstream of the dredge operations were not noticeable, although the channel substrate had been disturbed and displaced due to these activities. Channel substrates in this area primarily consist of small cobble and gravel interspersed with bedrock/boulder complexes. Dredge operations are less likely to generate fine suspended sediments in these areas.

Finer sediments derived from dredging are more likely found in the lower half of the river. They would generate turbid water immediately downstream of the dredge outflow. The Basin Plan gives exception to areas below dredges in the immediate zone of dilution. Dredge operations in the lower reaches of the river are limited. Dredging on private land requires a permit from the California Department of Fish and Game. Dredging on BLM lands require an additional permit from that agency. Dredging is not allowed on State Parks lands. The Bureau of Land Management is not renewing dredging permits. Unless the management plan objectives expand opportunities for recreational dredging, it is likely that dredging will diminish over time. Water quality in the South Yuba does not appear to be adversely impacted by these localized activities.

Electrical Conductivity

Electrical Conductivity is an estimate of the total dissolved salts in water. These salts are derived from natural and human sources; geologic formations, terrestrial runoff, atmospheric inputs, and bacterial metabolism. Elevated ion concentrations increase conductivity. Distilled water has a conductivity range of 0.5 – 3 micromhos per centimeter (µhos/cm).

The conductivity of rivers in the United States generally ranges from 50 to 1500 µhos/cm. A conductivity value ranging from 150 – 500 µhos/cm will support good mixed fisheries.\(^7\) A threshold value for the Yuba is not listed in the Basin Plan. However, it requires that conductivity shall not exceed 230 µhos/cm in the Sacramento River.\(^8\) The Sacramento River is the ultimate receiving water for the South Yuba.

Data collected was normalized to 25 degrees Centigrade. In the river itself, the minimum conductivity reading was 34 µhos/cm at Lang Crossing; the maximum was 171.1 µhos/cm at South Yuba above Poorman Creek. The average reading throughout the study area over the entire study period was 101.2 µhos/cm. These results suggest that the South Yuba has a relatively low salt concentration, characteristic of rivers running through granitic substrates. Primary food production may be inhibited by low conductivity.

\(^7\) EPA's Citizen Monitoring Manual
\(^8\) Basin Plan Reference
Nitrates

Presently, the only national water quality criteria in existence are for nitrate nitrogen and phosphorus. No standard is outlined in the Basin Plan. In 1976, in EPA’s publication entitled *Quality Criteria for Water* (also known as the Red Book), EPA presented ambient water quality criteria for nitrates, nitrites and phosphorus. The criterion for nitrate nitrogen is 10 parts per million for the protection of domestic water supplies. The nitrate criteria were intended to prevent overenrichment and to protect human and animal health. Nitrate concentration was tested all along the South Yuba. The nitrate concentration of the South Yuba River below the town of Washington was 1 part per million on January 3, 2001 and less than 0.25 part per million on May 31 and June 24, 2001. Nitrate concentration was 1 part per million at Purdon Crossing Downstream and Little Rock Creek on February 1, 2001.

None of the samples exceeded 1 part per million. These results indicate no elevated nitrate concentrations were present during the study period. No problem was identified with Washington area homes and their septic tanks along the river.

Metals

Arsenic, chromium and mercury were tested at locations likely to be impacted by historic mining activities. The land management team and water quality consultant decided to take samples at four South Yuba River tributaries; Diggins, Humbug, Poorman, and Diamond Creeks, during or shortly after storm events to determine if arsenic, chromium or mercury was contained in these tributaries at actionable levels. The Basin Plan has no chromium standard. Nationally, the chromium standard is 57 micrograms per liter for surface waters.

No metals were detected in any samples with the exception of chromium at Humbug Creek upstream of the Diggins Creek confluence and Diggins Creek at Hiller Tunnel. None of these results were at or near the national standard. A sample taken from Scotchman Creek was received from a local resident and analyzed. No metals were detected in the Scotchman Creek sample.

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10 USEPA National Ambient Water Quality Criteria to Protect Fresh Water Aquatic Life.
Table 11: Total Chromium Results

<table>
<thead>
<tr>
<th>Site</th>
<th>Date</th>
<th>Result (µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humbug Creek UP</td>
<td>1/11/01</td>
<td>37.4</td>
</tr>
<tr>
<td>Humbug Creek UP</td>
<td>4/20/01</td>
<td>8.4</td>
</tr>
<tr>
<td>Diggins Creek – Hiller</td>
<td>1/11/01</td>
<td>6.9</td>
</tr>
<tr>
<td>Diggins Creek – Hiller</td>
<td>4/20/01</td>
<td>14.2</td>
</tr>
</tbody>
</table>

Other sampling conducted by outside agencies indicate that mercury may be a problem at very low concentrations in one of the vertical shafts to the west of the Humbug drainage and in the Lake City tunnel. Further evaluation is necessary to determine if biomagnification in fish poses a potential health risk in aquatic species or humans. Concentrations of other metals do not likely pose a health risk to humans or adversely impact the environment.

**Concurrent Studies**

The South Yuba River Citizens’ League (SYRCL) was also conducting a limited water quality assessment on the South Yuba River during the study period. Their Riverscience Director and staff of volunteers played an integral part in the Enterococcus bacteria assessment. Overall, their data correlate well with the data in this report.

**Recommended Actions**

At this point in time, no immediate human health or environmental risks have been identified in this assessment with the exception of Enterococcus bacteria. The State Water Resources Control Board, the California Department of Health Services, and the US Environmental Protection Agency are working in concert to derive conclusions that can be drawn from the results in this and other companion studies. The river has generally good water quality.

This study was a generalized assessment. More specific research as outlined below is warranted:

- **Upper South Yuba River** – review timber harvest plans with careful emphasis on reducing impacts to South Yuba River and its tributaries. Potentially increase enforcement and oversight at harvest operations.
- **Humbug Creek Drainage** – investigate sediment transport, mercury biomagnification and methylation
- **South Yuba River tributaries** – evaluate sediment transport and bacteria in tributary drainages. Although not included in this assessment, Scotchman Creek and Spring Creeks had observable reduction in water clarity during storm events.
- **Lower South Yuba River below Humbug Creek** – assessment of potential impacts due to erosion with specific emphasis on sediment sources above Hoyt Crossing.
- **Entire South Yuba River** – assessment of anadromous fish habitat suitability with specific emphasis on temperature threshold limits and metabolic adaptations to temperature extremes in the existing fish population and surrounding foothill rivers containing anadromous fish and

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11 Personal Communication, Charles Alpers, Ph.D., US Geological Survey
aquatic habitats of similar character. Reduce the impact of sediment contributed by eroding hydraulic diggins.
References

8. U.S. Environmental Protection Agency, National Ambient Water Quality Criteria to Protect Fresh Water Aquatic Life
Appendix 1: Sampling protocol, locations, parameters and frequencies
Appendix 2: Data Charts
Appendix 3: Quality Assurance Project Plan
Appendix 4: Field Data Sheets
Appendix 5: Temperature Tolerances of Anadromous Fish

Figure 1: Turbidity Results for Humbug Creek Watershed
Figure 2: Fish turbidity tolerances

Table 1: List of Water Quality Characteristics and Analytical Methods
Table 2: pH readings exceeding Basin Plan limits
Table 3: *E. coli* readings exceeding Basin Plan standard
Table 4: *Enterococcus* Results from Enterolert Tests
Table 5: Temperatures in the Lower Watershed
Table 6: Turbidity Readings in the Humbug Creek Drainage (NTU)
Table 7: Turbidity in the Lower Watershed in February 2001
Table 8: Turbidity in the Lower Watershed in March 2002
Table 9: Turbidity in the Watershed Continuum
Table 10: Turbidity in the Lower Watershed in November 2001
Table 11: Total Chromium Results
Appendix 1: South Yuba Recreation Survey
Water Quality Field Sampling Instructions

Purpose: To survey the impacts of landowners, recreationists and continuous mine drainage on water quality.

Equipment Needed:

- Multi-meter
- Flagging tape
- Data Form(s)
- Sample Bottles
- Ice Packs
- Tree Tags
- Nails
- Sample Bottle Bar Codes
- Paper Towels
- Plastic bags
- Sharpie Pens
- Regular Thermometer
- Turbidity vials

Sampling Instructions:

*Physical Characteristic Sampling:*

1. Connect probe to multi-meter.
2. Turn meter on.
3. Place probe in running water at least six inches from the surface.
4. Allow readings to stabilize for one minute.
5. Record temperature on the data form.
7. Set mode to pH. Record pH.
8. Remove the probe. Rinse them with distilled water. Lightly shake the water off.
9. Turn the meter off.
10. Disconnect the probe.
11. Place instrument back into case.
**Biological Sampling:**

Note: One sample will be taken at each location, two on a quarterly basis.

1. Record the sample location on the sample bottle and the laboratory form with a waterproof marker.

2. Open the bottle. **Do not touch the inside of the bottle or cap with your hands or anything else that may be a source of contamination.** The tablet can remain or be removed. It is there to neutralize residual chlorine in tap water. It will not affect our samples.

3. Position yourself downstream. Place the bottle in the water at a 45 degree angle to the surface. Scoop up a container of water. Replace the cap. Wipe off any residual water if necessary.

4. Bag the sample and place in cooler. Repeat for subsequent samples.

**Sample Handling:**

All samples are to be kept as cool as possible until received by the laboratory. Place samples in ice chests prior to transport.

Fill out the Chain of Custody form listing the Sample Identity, Date, Time, and Relinquished by, Print Name/ Company, Date/Time. The lab will complete the paperwork for the bacteria tests.

Take the samples to Cranmer Engineering as close to 4:00 pm as possible. Talk to Rudy.

Cranmer Engineering  
1188 E. Main Street, GV (cross street Hudson)  
273-7284

Ask them for a copy of the Chain of Custody form. Sign and return it to the office. Place the form into the daily folder.