Cache Creek
Total Suspended Sediment and Turbidity Monitoring Program

2004 Annual Report

Cache Creek in flood. Photo taken looking upstream from Road 94B Bridge on February 27, 2004. (Photo: Chris Hammersmark)

September 8, 2005

Prepared for:
Community Development Agency
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Introduction

To provide baseline data on the spatial and temporal variation of sediment concentration and turbidity along the lower reaches of Cache Creek, a monitoring program was implemented in January 2004. Sampling was conducted at several locations along the creek within the CCMRP project area at one month intervals throughout the year. In addition several monitoring trips were made in response to precipitation events, which caused high discharge conditions in Cache Creek. This document reports the results of this sediment monitoring program for the 2004 monitoring season.

Methods

Six locations, shown in Figure 1, were sampled 15 times during the 2004 calendar year. Sampling began on January 17, 2004 and concluded on December 31, 2004. Dates for each of the 15 sampling trips are provided in Table 1. Three sampling trips (February 18, 2004; February 27, 2004; and December 31, 2004) were conducted to capture event based high flow conditions and the remaining 12 trips followed the scheduled monthly sampling. In addition, the outlet of Gordon Slough was sampled seven times during periods of agricultural return flow beginning April 19, 2004 and concluding October 18, 2004. On five occasions (April 19, 2004; May 17, 2004; June 17, 2004; July 18, 2004; and September 18, 2004) no surface flow occurred at Rd 87 (Esparto Bridge). On these occasions, a scour hole with standing water, located beneath and downstream of the bridge was sampled. On three occasions (August 17, 2004; September 18, 2004; and October 18, 2004), Cache Creek at Road 99W (Yolo) was dry and therefore sampling was not possible.

For each sampling trip, sampling commenced at the furthest upstream site, Arbuckle Road (Rumsey Bridge), proceeded downstream to Road 85 (Capay Bridge), Road 87 (Esparto Bridge), Road 89/I-505 Bridge, Road 94B, Gordon Slough, and concluded at Road 99W (Yolo). During low flow conditions, I-505 Bridge samples were substituted with wading samples collected upstream at Road 89. During periods of agricultural irrigation return flow from Gordon Slough, sampling was conducted first within Cache Creek upstream of the Gordon Slough confluence, and then within Gordon Slough just above the confluence with Cache Creek.

At each location, two 250 ml water samples were collected for laboratory analysis of turbidity and total suspended sediment (TSS). After collection, samples were kept cool until delivery to the DANR Analytical Lab at UC Davis. In addition, at each location, turbidity was measured *in situ* with a Hydrolab Quanta multi-parameter probe. Before each sampling session, the probe was calibrated with a turbidity calibration standard in the range of the expected creek water turbidity. After each session the calibration of the probe was verified with a turbidity calibration standard. When discharge was less than ~3000 cubic feet per second (cfs) measurements and water samples were taken by wading directly in the main channel and sampling at a depth of one foot below the water surface. At discharges above ~3000 cfs, samples were collected from bridges at each site with a depth integrating suspended sampler lowered to a depth of approximately one foot from the water surface.

Results and Discussion

Turbidity and suspended sediment data for each of the 15 sampling sessions are summarized in Table 1. In addition, to in situ measured (field) turbidity, DANR measured (lab) turbidity, and DANR measured (lab) TSS, discharge at Road 99W (Yolo) at the time of sampling is provided in Table 1. Turbidity values have been reported to the precision prescribed by Andersen 2004. For most field measurements, turbidity was observed to vary during the sampling. At each site turbidity was recorded every minute until three consecutive measurements were within 10% of the others. In Table 1, the average of these three readings are reported. At each site two 250 ml samples were collected. The two values reported by the analytical lab have been averaged in Table 1. All raw data from the DANR lab are provided in Appendix A. Field data from the February 18, 2004 sampling is not available because the turbidities experienced in the field were beyond the range of the HydroLab multi-parameter probe. For this reason, DANR lab data were chosen for the graphical presentation, and discussion that follows.

The timing and corresponding flow level of Cache Creek at Road 99W (Yolo) for each of the 15 sampling sessions are shown superimposed on the Cache Creek hydrograph in Figure 2. Sessions, which included Gordon Slough sampling, are represented differently.

Data from the 2004 monitoring season show a number of apparent correlations. Specifically, the correlation between turbidity and TSS, and the correlation between turbidity and discharge are readily apparent. Turbidity and TSS concentrations are often correlated. It is for this reason, turbidity is often used as a proxy for TSS. Higher turbidity values generally correspond to higher values of suspended sediment. It should be noted that a number factors including sediment composition and particle size, biological activity (bio-film growth), air entrainment and turbulence affect this correlation. Figure 3 provides a graphical display of the correlation between the turbidity and TSS data collected during the monitoring period. Each sampling trip is represented as a separate series of data points in Figure 3. Upon observation, a positive correlation in the form of a linear relationship is apparent between turbidity and TSS.

Turbidity and discharge are also often correlated. Higher turbidity values are generally observed at higher discharges because more sediment particles are resuspended due to the increased wetted channel, increased shear stresses due to a deeper water column, and increased turbulence associated with increased discharge. Figure 4 provides a graphical display of turbidity vs. discharge for samples taken at the Road 99W (Yolo) sampling location. Only Road 99W samples are displayed because accurate discharge values are not available for the other sampling locations. A loose correlation is observed in the plotted data. It is important to note that many factors influence the turbidity/discharge correlation including, stage of the hydrograph (rising or falling), timing of the flood pulse (early season vs. late season), and recent flow history. Most of the data collected in the 2004 monitoring season are grouped in the lower left corner of the plot because 11 of the 15 sampling sessions were conducted under lower flow conditions of 400 cfs or less.

A common observation in river systems is that turbidity increases in the downstream direction. The data collected in 2004 on Cache Creek do not appear to readily confirm this observation. A number of factors may be influencing the data and obscuring this result. Primarily the different flow rates observed at the time of sampling. Cache Creek is a flashy system, meaning that the flow rate in the creek rises and falls at a very rapid rate. For this reason, flood samples taken at two locations only hours apart are often taken at very different flow rates. Another factor influencing this expected trend is the dam and subsequent reservoir located on Cache Creek in Capay. This reservoir acts to trap sediment; therefore it is not surprising to see higher turbidity at the Arbuckle Road sampling site, than the downstream sampling sites. Furthermore during the summer months discharge at Arbuckle Road is much higher than downstream sampling sites, further complicating conclusions regarding the spatial variation of turbidity in Cache Creek. Downstream, this trend is also influenced in the low flow periods by the intermittent nature of the creeks flow. The substantial changes in stream slope and width along the length of lower Cache Creek also add to the complexity of suspended sediment transport.

Turbidity and TSS measurements made in Gordon Slough begin to demonstrate this slough's impacts upon Cache Creek's water quality. Every time that Gordon Slough was sampled its turbidity was found to be drastically higher than the creek waters. Through the low flow periods when Gordon slough was sampled, it was found to be 8 to 250 times more turbid than Cache Creek prior to mixing (based on laboratory turbidity data). On average it was found to be 67 times more turbid. Figure 5 shows two photographs taken April 19, 2004 of the mixing zone of a portion of the Gordon Slough waters with Cache Creek. At the time the photos were taken Cache Creek's turbidity above the Gordon Slough confluence was 2.2 NTU (lab), while Gordon Slough had a turbidity of 62 NTU (lab).

Strong agreement between the laboratory measured turbidity and the in situ measured is not generally observed. This is not altogether surprising. Different, properly calibrated turbidity probes often yield different values for identical samples. These differences are due to variations between instruments regarding beam wavelength used, sensor orientation, and dynamic (in situ) vs. static (in lab) measurement. Furthermore, turbidity is known to change rapidly after sampling. Turbidity monitoring protocols strongly advise the immediate measurement of turbidity, and suggest that sample preservation is not practical (ASTM 2003). Storage at the lab DANR lab prior to measurement ranged from 15 to 71 days for the 2004 monitoring samples. In addition, static (lab) measurements will likely be biased low if sand or coarse silt are present (Andersen 2004), as is common in Cache Creek suspended sediments collected under flood conditions. Laboratory measured values have been favored in this report because the field data set is incomplete (February 18, 2004 sample beyond the probe's range). It is important to note that while the turbidity values vary from instrument to instrument, the relative difference between measurements taken with the same calibrated probe are of the most value. In situ measurement continues to be tremendously valuable when used properly in a direct comparison framework, for the purpose of assessing the water clarity impacts of monitoring in channel activities, when immediate feedback is required. For more information regarding variations in turbidity measurement the reader is referred to Andersen (2004), which is available online.

Conclusions

The data provided in this report are valuable in forming a baseline for subsequent consideration of the effects to water quality of near-channel activities, such as vegetation removal, channel modification and various other restoration activities. Such activities, which generally occur during low flow conditions, are highly constrained by CVWQCB compliance standards regarding impacts to turbidity. A major concern driving the establishment of these standards is the introduction of mercury into the water column. Data from this study demonstrate that much more sediment and subsequently mercury are transported during the higher flow events, which occur during the winter and spring. The monitoring of turbidity and TSS should be continued in the future to improve understanding of the relationship between turbidity and TSS on Cache Creek, and more importantly the relationship between turbidity and discharge. Specifically, future monitoring activities should focus on capturing more of the higher flow events, as this is when the vast majority of sediment is actively moving in the system. Lastly, if low flow impacts to the turbidity of Cache Creek are of great concern, then the impact of the agricultural return flow from the unregulated Gordon Slough should be addressed. As shown above, these turbidities are one to two orders of magnitude higher than those observed in Cache Creek above the Gordon Slough confluence. This significant difference in turbidity is observed when the flow rates of the two streams are often very similar.

References

Anderson, C.W., 2004, Turbidity, (version 2): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A6,section 6.7, accessed June, 20 2005 from http://water.usgs.gov/owq/FieldManual/Chapter6/6.7_contents.html.

ASTM International, 2003, D1889–00 Standard test method for turbidity of water, *in* ASTM International, Annual Book of ASTM Standards, Water and Environmental Technology, 2003, v. 11.01, West Conshohocken, Pennsylvania, 6 p.

Table 1 – Cache Creek discharge, field turbidity, laboratory turbidity and laboratory total suspended sediment (TSS) values for the 2004 monitoring period. Notes follow on next page.

Date	Yolo Q (cfs)[1]	Parameter [2]	Arbuckle Rd	Rd 85	Rd 87[3]	Rd 89/I-505[4]	Rd 94B	Gordon Slough[5]	Rd 99W[6]
01/17/04	250	Field Turbidity	12	19	18	22	27	ns	40
		Lab Turbidity	10	15	15	18	20	ns	37
		Lab TSS	9.0	17.0	13.0	16.0	21.0	ns	32.0
02/16/04	72	Field Turbidity	28	60	18	20	35	ns	24
		Lab Turbidity	25	45	22	18	28	ns	20
		Lab TSS	14.5	43.5	7.5	17.5	14.5	ns	17.0
02/18/04	12300	Field Turbidity	abv	abv	abv	abv	abv	ns	abv
		Lab Turbidity	1400	2100	2050	2300	2300	ns	2250
		Lab TSS	1074.5	1361.0	1438.0	1511.0	1567.0	ns	1465.0
02/27/04	6120	Field Turbidity	590	790	840	880	930	ns	980
		Lab Turbidity	650	760	970	970	980	ns	860
		Lab TSS	504.0	689.0	682.0	665.0	748.0	ns	765.0
03/18/04	388	Field Turbidity	33	21	22	24	27	ns	49
		Lab Turbidity	21	21	21	24	27	ns	46
		Lab TSS	12.5	16.0	15.0	19.0	21.5	ns	53.0
04/19/04	37	Field Turbidity	19	4.6	2.4	1.8	2.0	71	15
		Lab Turbidity	15	4.8	2.4	3.0	2.2	63	12
		Lab TSS	12.5	4.0	<4	4.0	<4	40.0	7.5
05/17/04	12	Field Turbidity	23	5.3	20	0.0	0.8	140	2.5
		Lab Turbidity	21	5.6	16	2.6	2.4	140	4.9
		Lab TSS	31.5	6.0	12.0	4.0	4.5	83.5	5.0
06/17/04	5	Field Turbidity	25	4.8	14	0.4	2.2	47	3.2
		Lab Turbidity	16	5.2	13	2.5	4.5	34	5.3
		Lab TSS	21.5	6.5	6.0	<4	6.5	28.0	5.5
07/18/04	13	Field Turbidity	32	19	7.1	0.0	3.8	140	14
		Lab Turbidity	9.6	15	8.0	1.8	5.8	95	15
		Lab TSS	11.0	16.0	6.5	<4	6.5	90.5	9.0
08/17/04	0	Field Turbidity	16	7.7	1.6	0.0	0.6	75	ns
		Lab Turbidity	14	7.1	2.3	0.7	2.3	50	ns
		Lab TSS	20.0	10.0	4.0	4.0	5.0	33.5	ns
09/18/04	0	Field Turbidity	8.1	1.1	5.0	0.0	0.0	110	ns
		Lab Turbidity	4.9	1.1	4.4	0.9	1.0	85	ns
		Lab TSS	8.0	4.0	5.0	5.5	5.5	72.0	ns
10/18/04	0	Field Turbidity	9.3	2.3	1.3	0.6	0.0	100	ns
		Lab Turbidity	5.0	1.3	1.3	0.2	0.4	88	ns
		Lab TSS	17.0	6.5	4.5	9.0	<4	61.5	ns
11/17/04	12	Field Turbidity	2.0	1.5	0.0	0.0	0.0	ns	1.8
		Lab Turbidity	1.6	1.6	0.5	0.5	0.5	ns	1.4
		Lab TSS	<4	<4	<4	<4	<4	ns	<4
12/15/04	45	Field Turbidity	3.8	6.7	3.2	2.6	8.7	ns	5.6
		Lab Turbidity	1.5	2.2	1.2	0.7	4.2	ns	3.5
		Lab TSS	<4	<4	4.0	<4	7.0	ns	4.0
12/31/04	2080	Field Turbidity	460	360	350	360	460	ns	750
		Lab Turbidity	440	330	330	340	390	ns	690
		Lab TSS	282.0	208.0	198.0	219.0	258.0	ns	444.0

Table 1 Notes:

1. Provisional discharge values obtained from the California Data Exchange Center (http://cdec.water.ca.gov). Data is provisional and is subject to change.
2. Each 'lab' value reported is the average of the two samples submitted to UC Davis DANR analytical lab. Reporting precision follows the guidelines prescribed by Andersen 2004. Nephelometric Turbidity Units (NTU) are used for turbidity, and units of mg/L used for total suspended sediment (TSS).
3. No surface flow at Rd 87 (Esparto Bridge) on 4/19/04, 5/17/04, 6/17/04, 7/18/04 9/18/04 samples. Standing water scour hole sampled.
4. 2/18/04 and 2/27/04 samples collected from the I-505 bridge. All others collected at Road 89.
5. Gordon Slough not sampled in winter. Sampling began 4/19/04 and ended 10/18/04 in response to agricultural return flow in Gordon Slough.
6. No surface flow at Road 99W on 8/17/04, 9/18/04, 10/18/04 samples. No sampling conducted.
7. Values reported, as "ns" indicate no sample or measurement was made.

Figure 1 – Total suspended solids and turbidity monitoring locations along Cache Creek.

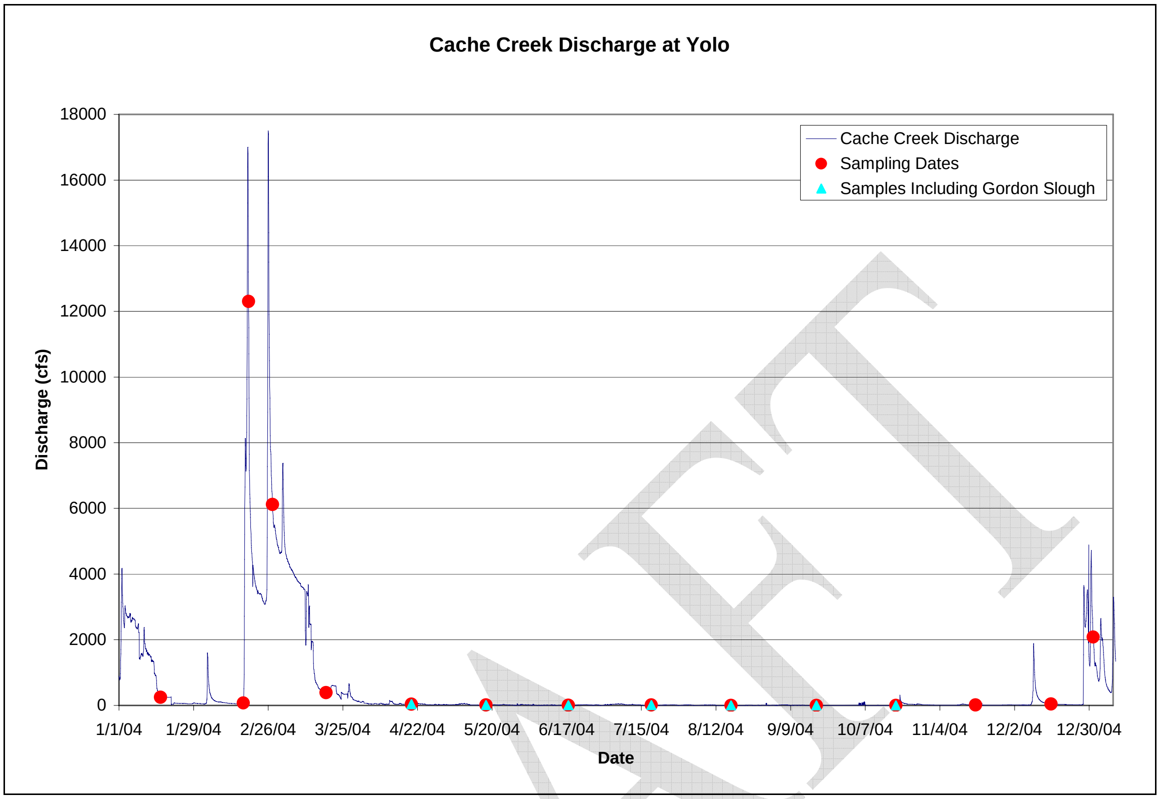

Figure 2 – Cache Creek discharge reported at the Road 99W (Yolo) monitoring site. Sediment and turbidity sampling dates are shown as red circles. Sampling sessions, which included sampling of Gordon Slough, are displayed as turquoise triangles. Provisional discharge values obtained from the California Data Exchange Center (http://cdec.water.ca.gov). Data are provisional and are subject to change.

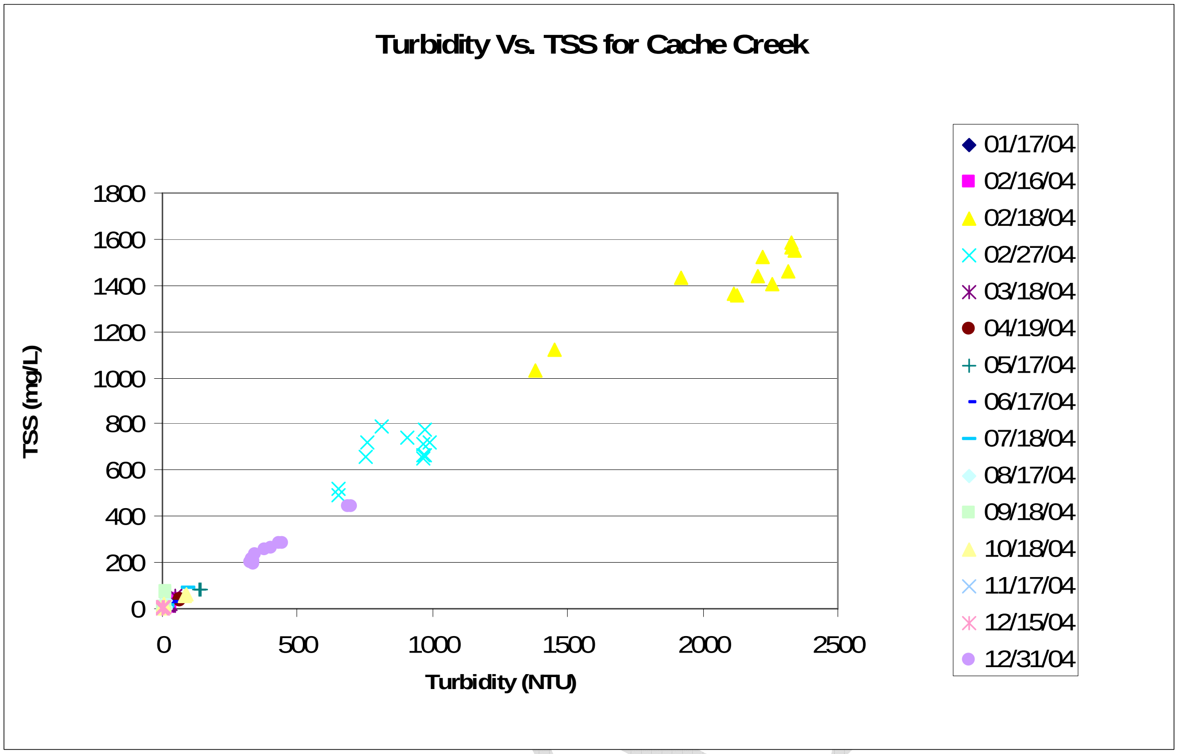

Figure 3 – TSS vs. turbidity for Cache Creek (including Gordon Slough samples). A linear correlation between turbidity and TSS is apparent. Higher turbidity values indicate higher values of TSS.

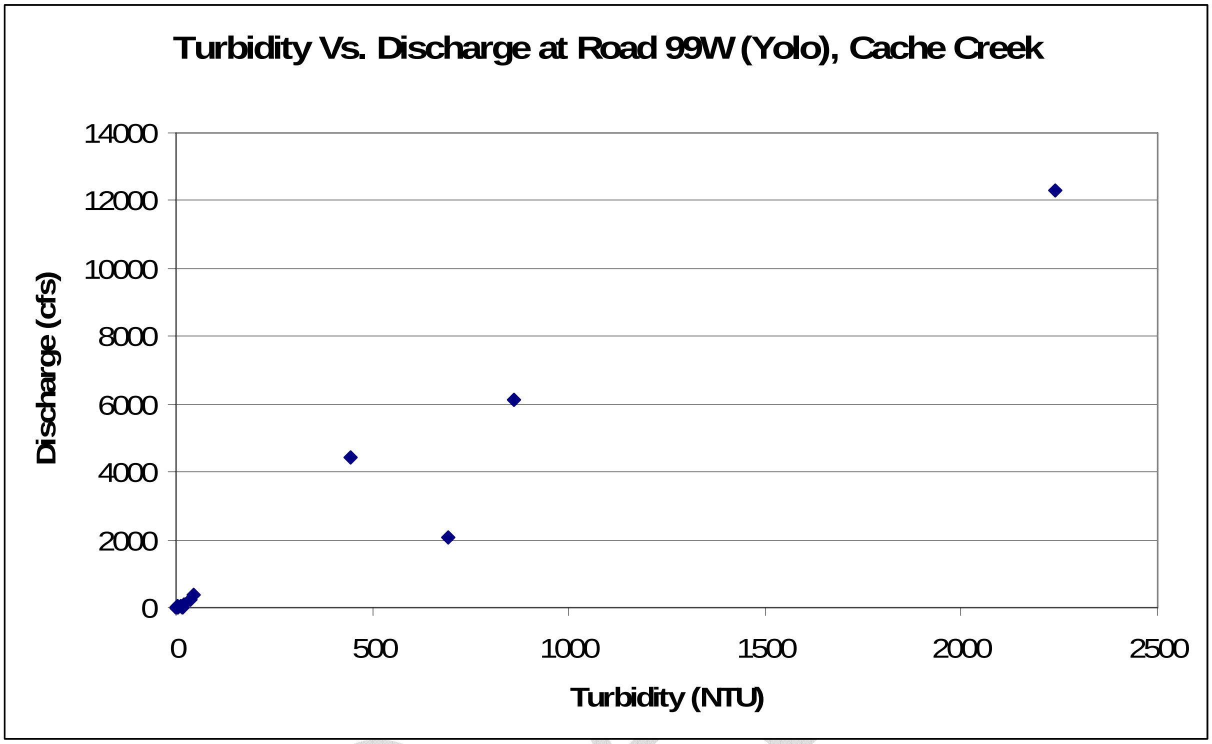

Figure 4 – Discharge vs. turbidity at Road 99W (Yolo), Cache Creek. A loose linear correlation between turbidity and discharge is apparent. Higher turbidity values are present under elevated creek discharge.

Figure 5 – Photographs taken from the upstream side of Road 94B Bridge showing the mixing zone of Gordon Slough and Cache Creek. Photos taken on April 19, 2004. At the time of the photo Cache Creek turbidity upstream of the confluence was 2.2 NTU (lab), while that of Gordon Slough was 62 NTU (lab). Photos only show a portion of the Gordon Slough effluent. More highly turbid water joined the creek ~100 yards downstream, downstream of the bridge. (Photos: Chris Hammersmark)

Appendix A
UC Davis DANR Lab Data

SUBMITTED BY: SCHLADOW, S. GEOFF
DANR SECTION: FAC: CIV & ENV ENG, UCD
COPY TO: HAMMERSMARK, CHRIS
COMMODITY: River Water

http://danranlab.ucanr.org

WORK REQ #: 04W111
OF SAMPLES: 12
DATE RECEIVED: 01/23/04
DATE REPORTED: 05/04/04
DANR CLIENT #: SCHS1
TURN AROUND TIME IN WORKING DAYS: 71

Sample Type: WATER Date Sampled: 1.17.04

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity NTU
1	RB	10	10.2
1 dup	RB	8	10.5
2	RB	8	8.9
3	CB	16	15.4
4	CB	18	14.2
5	EB	14	14.4
6	EB	12	15.6
7	Rd 89	14	18.0
8	Rd 89	18	17.1
9	Rd 94B	22	24.1
10	Rd 94B	20	15.2
10 dup	Rd 94B	22	15.8
11	Rd 99W	36	36.7
12	Rd 99W	28	37.6
12 dup	Rd 99W	30	38.0
Method Detection Limit:		5	0.1
Blank Concentration:		-	0.1
Standard Ref as Tested:		-	796
Standard Ref Acceptable:		-	800±16
Standard Reference:		-	800 NTU

NOTE: The SOP # (Standard Operating Procedure number) is a reference to the laboratory method used.
The SOP heading in this Excel file is linked to the method summary on the Laboratory website. http://danranlab.ucanr.org
NOTE: No result within this report is accurate to more than 3 significant figures. More figures may be present due to software rounding rules.

Checked and Approved: *{electronically signed by Traci Francis}*
Traci Francis, Laboratory Supervisor

Reviewed and Approved: *{electronically signed by Dirk Holstege}*
Dirk Holstege, Director

Please address questions regarding these results to Lab Director Dirk Holstege at (530) 752-0148 or dmholstege@ucdavis.edu.

SUBMITTED BY: SCHLADOW, S. GEOFF
DANR SECTION: FAC: CIV & ENV ENG, UCD
COPY TO: HAMMERSMARK, CHRIS
COMMODITY: River Water

http://danranlab.ucanr.org

WORK REQ #: 04W117
OF SAMPLES: 12
DATE RECEIVED: 02/17/04
DATE REPORTED: 05/05/04
DANR CLIENT #: SCHS1
TURN AROUND TIME IN WORKING DAYS: 56

Sample Type: WATER Date Sampled: 2-16-04

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity NTU
1	RB	16	25.3
1 dup	RB	NES	24.6
2	RB	13	24.4
3	CB	43	41.2
4	CB	44	48.9
5	EB	7	15.9
6	EB	8	27.3
7	Rd 89	21	16.6
8	Rd 89	14	19.4
9	Rd 94B	12	28.9
10	Rd 94B	17	27.2
10 dup	Rd 94B	NES	27.3
11	Rd 99W	18	20.2
12	Rd 99W	16	20.2
12 dup	Rd 99W	NES	19.8
Method Detection Limit:		5	0.1
Blank Concentration:		0	0.1
Standard Ref as Tested:		36.0	796
Standard Ref Acceptable:		39.1±6.4	800±16
Standard Reference:		WWR HARD	800 NTU

NOTE: The SOP # (Standard Operating Procedure number) is a reference to the laboratory method used.
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Traci Francis, Laboratory Supervisor

Reviewed and Approved: *{electronically signed by Dirk Holstege}*
Dirk Holstege, Director

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SUBMITTED BY:	SCHLADOW, S. GEOFF	WORK REQ #:	04W125
DANR SECTION:	FAC: CIV & ENV ENG, UCD	# OF SAMPLES:	24
COPY TO:	HAMMERSMARK, CHRIS	DATE RECEIVED:	03/01/04
COMMODITY:	River Water	DATE REPORTED:	05/06/04
		DANR CLIENT #:	SCHS1
		TURN AROUND TIME IN WORKING DAYS:	48

http://danranlab.ucanr.org

Sample Type: WATER Date Sampled: 2/18/04 & 2/27/04

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity NTU
1	RB	1119	1449
1 dup	RB	1058	1422
2	RB	1030	1379
3	CB	1358	2128
4	CB	1364	2112
5	EB	1442	2205
6	EB	1434	1919
7	Rd 89	1458	2316
8	Rd 89	1564	2328
9	Rd 94B	1552	2339
10	Rd 94B	1582	2326
10 dup	Rd 94B	1568	2337
11	Rd 99W	1524	2219
12	Rd 99W	1406	2258
13	RB	491	652
14	RB	517	653
15	CB	658	752
16	CB	720	759
17	EB	650	967
18	EB	714	966
19	Rd 89	662	969
20	Rd 89	668	965
20 dup	Rd 89	718	978
21	Rd 94B	720	992
22	Rd 94B	776	972
23	Rd 99W	786	811
24	Rd 99W	744	909
24 dup	Rd 99W	776	914
Method Detection Limit:		5	1
Blank Concentration:		0	0
Standard Ref as Tested:		26.0	792
Standard Ref Acceptable:		29.7±5.8	800±16
Standard Reference:		WWR HARDA	800 NTU

NOTE: The SOP # (Standard Operating Procedure number) is a reference to the laboratory method used.
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SUBMITTED BY:	SCHLADOW, S. GEOFF	WORK REQ #:	04W141
DANR SECTION:	FAC: CIV & ENV ENG, UCD	# OF SAMPLES:	12
COPY TO:	HAMMERSMARK, CHRIS	DATE RECEIVED:	03/19/04
COMMODITY:	River Water	DATE REPORTED:	05/14/04
		DANR CLIENT #:	SCHS1
		TURN AROUND TIME IN WORKING DAYS:	40

http://danranlab.ucanr.org

Sample Type: WATER Date Sampled: 3-18-04

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity NTU
1	RB	13	21.5
1 dup	RB	NES	22.0
2	RB	12	20.9
3	CB	16	21.1
4	CB	16	20.2
5	EB	17	21.3
6	EB	13	20.2
7	Rd 89	20	23.5
8	Rd 89	18	24.1
9	Rd 94B	23	27.0
10	Rd 94B	20	26.1
10 dup	Rd 94B	NES	26.3
11	Rd 99W	52	46.6
12	Rd 99W	54	46.2
12 dup	Rd 99W	NES	45.8
Method Detection Limit:		4	0.1
Blank Concentration:		0	0.0
Standard Ref as Tested:		30.0	808
Standard Ref Acceptable:		29.7±5.8	800±16
Standard Reference:		WWR HARDA	800 NTU

NOTE: The SOP # (Standard Operating Procedure number) is a reference to the laboratory method used.
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Dirk Holstege, Director

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SUBMITTED BY:	SCHLADOW, S. GEOFF	WORK REQ #:	04W168
DANR SECTION:	FAC: CIV & ENV ENG, UCD	# OF SAMPLES:	14
COPY TO:	HAMMERSMARK, CHRIS	DATE RECEIVED:	04/22/04
COMMODITY:	River Water	DATE REPORTED:	06/15/04
		DANR CLIENT #:	SCHS1
		TURN AROUND TIME IN WORKING DAYS:	38

http://danranlab.ucanr.org

Sample Type: WATER Date Sampled: 4/19/04

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity NTU
1	RB	11	15.1
1 dup	RB	NES	16.2
2	RB	14	14.0
3	CB	4	4.7
4	CB	<4	4.9
5	EB	<4	1.8
6	EB	<4	2.9
7	Rd 89	4	3.0
8	Rd 89	<4	2.9
9	Rd 94B	<4	1.8
10	Rd 94B	<4	2.5
10 dup	Rd 94B	NES	2.1
11	GS	45	63.1
12	GS	35	63.0
13	Rd 99W	8	12.2
14	Rd 99W	7	12.4
14 dup	Rd 99W	NES	12.7
Method Detection Limit:		4	0.1
Blank Concentration:		0	0.0
Standard Ref as Tested:		28.0	800
Standard Ref Acceptable:		29.7±5.8	800±16
Standard Reference:		WWR HARDA	800 NTU

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Checked and Approved: *{electronically signed by Traci Francis}*
Traci Francis, Laboratory Supervisor

Please address questions regarding these results to Lab Director Dirk Holstege at (530) 752-0148 or dmholstege@ucdavis.edu.

SUBMITTED BY: SCHLADOW, S. GEOFF
DANR SECTION: FAC: CIV & ENV ENG, UCD
COPY TO: HAMMERSMARK, CHRIS
COMMODITY: River Water

http://danranlab.ucanr.org

WORK REQ #: 04W177
OF SAMPLES: 14
DATE RECEIVED: 05/18/04
DATE REPORTED: 06/29/04
DANR CLIENT #: SCHS1
TURN AROUND TIME IN WORKING DAYS: 30

Sample Type: WATER Date Sampled: 5/17/04

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity NTU
1	RB	33	19.9
1 dup	RB	NES	21.1
2	RB	30	22.8
3	CB	6	5.4
4	CB	6	5.7
5	EB	11	16.0
6	EB	13	15.8
7	Rd 89	5	2.8
8	Rd 89	<4	2.3
9	Rd 94B	4	2.4
10	Rd 94B	5	2.3
10 dup	Rd 94B	NES	2.9
11	GS	85	139.4
12	GS	82	138.3
13	Rd 99W	4	5.1
14	Rd 99W	6	4.6
14 dup	Rd 99W	NES	5.1

	TSS	Turbidity
Method Detection Limit:	4	0.1
Blank Concentration:	0	0.0
Standard Ref as Tested:	28.0	800
Standard Ref Acceptable:	29.7±5.8	800±16
Standard Reference:	WWR HARDA	800 NTU

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Checked and Approved: *{electronically signed by Rani Singh}*
Rani Singh, Chemist

Please address questions regarding these results to Lab Director Dirk Holstege at (530) 752-0148 or dmholstege@ucdavis.edu.

SUBMITTED BY: SCHLADOW, S. GEOFF
DANR SECTION: FAC: CIV & ENV ENG, UCD
COPY TO: HAMMERSMARK, CHRIS
COMMODITY: River Water

http://danranlab.ucanr.org

WORK REQ #: 04W196
OF SAMPLES: 14
DATE RECEIVED: 06/17/04
DATE REPORTED: 08/05/04
DANR CLIENT #: SCHS1
TURN AROUND TIME IN WORKING DAYS: 35

Sample Type: WATER Date Sampled: 06/17/04

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity [SOP 810] NTU
1	RB	22	14.3
1 dup	RB	NES	14.7
2	RB	21	17.8
3	CB	5	5.2
4	CB	8	5.2
5	EB	5	12.4
6	EB	7	13.1
7	Rd 89	<4	2.5
8	Rd 89	<4	2.4
9	Rd 94B	6	5.1
10	Rd 94B	7	3.8
10 dup	Rd 94B	NES	3.6
11	GS	29	37.2
12	GS	27	31.6
13	Rd 99W	7	5.6
14	Rd 99W	4	5.0
14 dup	Rd 99W	NES	5.3

	TSS	Turbidity
Method Detection Limit:	4	0.1
Blank Concentration:	0	0.0
Standard Ref as Tested:	31.0	210
Standard Ref Acceptable:	29.7±5.8	200±10
Standard Reference:	WWR HARDA	200 NTU

NOTE: The SOP # (Standard Operating Procedure number) is a reference to the laboratory method used.
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Checked and Approved: *{electronically signed by Traci Francis}*
Traci Francis, Laboratory Supervisor

Reviewed and Approved: *{electronically signed by Dirk Holstege}*
Dirk Holstege, Director

Please address questions regarding these results to Lab Director Dirk Holstege at (530) 752-0148 or dmholstege@ucdavis.edu.

SUBMITTED BY: SCHLADOW, S. GEOFF
DANR SECTION: FAC: CIV & ENV ENG, UCD
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COMMODITY: River Water

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WORK REQ #: 05W010
OF SAMPLES: 14
DATE RECEIVED: 07/19/04
DATE REPORTED: 08/10/04
DANR CLIENT #: SCHS1
TURN AROUND TIME IN WORKING DAYS: 17

Sample Type: WATER Date Sampled: 7/18/04

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity [SOP 810] NTU
1	RB	10	9.4
1 dup	RB	NES	10.9
2	RB	12	9.8
3	CB	17	15.6
4	CB	15	14.0
5	EB	7	8.5
6	EB	6	7.4
7	Rd 89	<4	1.7
8	Rd 89	<4	1.9
9	Rd 94B	7	5.6
10	Rd 94B	6	5.9
10 dup	Rd 94B	NES	5.8
11	GS	90	94.8
12	GS	91	95.5
13	Rd 99W	10	12.8
14	Rd 99W	8	16.1
14 dup	Rd 99W	NES	14.8
Method Detection Limit:		4	0.1
Blank Concentration:		0	0.0
Standard Ref as Tested:		28.6	209
Standard Ref Acceptable:		29.7±5.8	200±10
Standard Reference:		WWR HARDA	200 NTU

NOTE: The SOP # (Standard Operating Procedure number) is a reference to the laboratory method used.
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Traci Francis, Laboratory Supervisor

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SUBMITTED BY: SCHLADOW, S. GEOFF
DANR SECTION: FAC: CIV & ENV ENG, UCD
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COMMODITY: River Water

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WORK REQ #: 05W029
OF SAMPLES: 12
DATE RECEIVED: 08/17/04
DATE REPORTED: 09/08/04
DANR CLIENT #: SCHS1
TURN AROUND TIME IN WORKING DAYS: 16

Sample Type: WATER Date Sampled: 8/17/04

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity [SOP 810] NTU
1	RB	21	16.4
1 dup	RB	NES	16.2
2	RB	19	12.4
3	CB	9	7.0
4	CB	11	7.2
5	EB	5	2.6
6	EB	<4	1.9
7	Rd 89	4	0.7
8	Rd 89	<4	0.7
9	Rd 94B	6	2.6
10	Rd 94B	4	2.0
10 dup	Rd 94B	NES	2.2
11	GS	33	50.2
12	GS	34	50.0
12 dup	GS	NES	51.6
Method Detection Limit:		4	0.1
Blank Concentration:		0	0.0
Standard Ref as Tested:		162	210
Standard Ref Acceptable:		147±34	200±10
Standard Reference:		SOLIDS	200 NTU

NOTE: The SOP # (Standard Operating Procedure number) is a reference to the laboratory method used.
The SOP heading in this Excel file is linked to the method summary on the Laboratory website. http://danranlab.ucanr.org

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Checked and Approved: *{electronically signed by Traci Francis}*
Traci Francis, Laboratory Supervisor

Reviewed and Approved: *{electronically signed by Dirk Holstege}*
Dirk Holstege, Director

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SUBMITTED BY: SCHLADOW, S. GEOFF
DANR SECTION: FAC: CIV & ENV ENG, UCD
COPY TO: HAMMERSMARK, CHRIS
COMMODITY: River Water

http://danranlab.ucanr.org

WORK REQ #: 05W065
OF SAMPLES: 12
DATE RECEIVED: 09/30/04
DATE REPORTED: 10/26/04
DANR CLIENT #: SCHS1
TURN AROUND TIME IN WORKING DAYS: 19

Sample Type: WATER   Date Sampled: 9/18/2004

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity [SOP 810] NTU
1	RB	9	5.4
1 dup	RB	NES	4.9
2	RB	7	4.4
3	CB	<4	1.1
4	CB	4	1.1
5	EB	<4	4.2
6	EB	6	4.6
7	Rd 89	5	0.8
8	Rd 89	6	0.9
9	Rd 94B	6	0.7
10	Rd 94B	5	1.3
10 dup	Rd 94B	NES	0.9
11	GS	70	79.9
12	GS	74	90.3
12 dup	GS	NES	94.7
Method Detection Limit:		4	0.1
Blank Concentration:		0	0.0
Standard Ref as Tested:		142	209
Standard Ref Acceptable:		147±34	200±20
Standard Reference:		SOLIDS	200 NTU

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NOTE: The relative percent difference between duplicate samples is higher than expected due to the non-homogeneous nature of the sample material.

Checked and Approved: *{electronically signed by Traci Francis}*
Traci Francis, Laboratory Supervisor

Reviewed and Approved: *{electronically signed by Dirk Holstege}*
Dirk Holstege, Director

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SUBMITTED BY: SCHLADOW, S. GEOFF
DANR SECTION: FAC: CIV & ENV ENG, UCD
COPY TO: HAMMERSMARK, CHRIS
COMMODITY: River Water

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WORK REQ #: 05W081
OF SAMPLES: 12
DATE RECEIVED: 10/18/04
DATE REPORTED: 12/02/04
DANR CLIENT #: SCHS1
TURN AROUND TIME IN WORKING DAYS: 31

Sample Type: WATER   Date Sampled: 10/18/04

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity [SOP 810] NTU
1	RB	20	5.2
1 dup	RB	NES	4.9
2	RB	14	4.8
3	CB	7	1.1
4	CB	6	1.5
5	EB	4	1.6
6	EB	5	0.9
7	Rd 89	10	0.2
8	Rd 89	8	0.2
9	Rd 94B	<4	0.4
10	Rd 94B	<4	0.3
10 dup	Rd 94B	NES	0.3
11	GS	58	84.7
12	GS	65	91.5
12 dup	GS	NES	93.1
Method Detection Limit:		4	0.1
Blank Concentration:		0	0.0
Standard Ref as Tested:		115	208
Standard Ref Acceptable:		120±14	200±20
Standard Reference:		SOLIDSB	200 NTU

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Traci Francis, Laboratory Supervisor

Reviewed and Approved: *{electronically signed by Dirk Holstege}*
Dirk Holstege, Director

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SUBMITTED BY: SCHLADOW, S. GEOFF
DANR SECTION: FAC: CIV & ENV ENG, UCD
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COMMODITY: River Water

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WORK REQ #: 05W102
OF SAMPLES: 12
DATE RECEIVED: 11/17/04
DATE REPORTED: 12/09/04
DANR CLIENT #: SCHS1
TURN AROUND TIME IN WORKING DAYS: 15

Sample Type: WATER Date Sampled: 11/17/04

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity [SOP 810] NTU
1	RB	<4	1.6
1 dup	RB	NES	1.6
2	RB	<4	1.5
3	CB	<4	1.4
4	CB	<4	1.8
5	EB	<4	0.4
6	EB	<4	0.5
7	Rd 89	<4	0.5
8	Rd 89	<4	0.5
9	Rd 94B	<4	0.5
10	Rd 94B	<4	0.5
10 dup	Rd 94B	NES	0.6
11	Rd 99W	<4	1.5
12	Rd 99W	<4	1.3
12 dup	Rd 99W	NES	1.3

	TSS	Turbidity
Method Detection Limit:	4	0.1
Blank Concentration:	0	0.0
Standard Ref as Tested:	118	209
Standard Ref Acceptable:	120±14	200±20
Standard Reference:	SOLIDSB	200 NTU

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Checked and Approved: *{electronically signed by Traci Francis}*
Traci Francis, Laboratory Supervisor

Reviewed and Approved: *{electronically signed by Dirk Holstege}*
Dirk Holstege, Director

Please address questions regarding these results to Lab Director Dirk Holstege at (530) 752-0148 or dmholstege@ucdavis.edu.

SUBMITTED BY: SCHLADOW, S. GEOFF
DANR SECTION: FAC: CIV & ENV ENG, UCD
COPY TO: HAMMERSMARK, CHRIS
COMMODITY: River Water

http://danranlab.ucanr.org

WORK REQ #: 05W120
OF SAMPLES: 12
DATE RECEIVED: 12/20/04
DATE REPORTED: 02/04/05
DANR CLIENT #: SCHS1
TURN AROUND TIME IN WORKING DAYS: 28

Sample Type: WATER Date Sampled: 12/15/04

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity [SOP 810] NTU
1	RB	<4	1.7
1 dup	RB	NES	1.6
2	RB	<4	1.3
3	CB	<4	1.9
4	CB	<4	2.4
5	EB	<4	0.8
6	EB	4	1.5
7	Rd 89	<4	0.7
8	Rd 89	<4	0.6
9	Rd 94B	7	4.2
10	Rd 94B	7	4.2
10 dup	Rd 94B	NES	4.2
11	Rd 99W	5	4.0
12	Rd 99W	<4	2.9
12 dup	Rd 99W	NES	2.9

	TSS	Turbidity
Method Detection Limit:	4	0.1
Blank Concentration:	0	0.0
Standard Ref as Tested:	127	210
Standard Ref Acceptable:	120±14	200±20
Standard Reference:	SOLIDSB	200 NTU

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Checked and Approved: *{electronically signed by Rani Singh}*
Rani Singh, Chemist

Please address questions regarding these results to Lab Director Dirk Holstege at (530) 752-0148 or dmholstege@ucdavis.edu.

SUBMITTED BY:	SCHLADOW, S. GEOFF			WORK REQ #:	05W126
DANR SECTION:	FAC: CIV & ENV ENG, UCD	http://danranlab.ucanr.org		# OF SAMPLES:	12
COPY TO:	HAMMERSMARK, CHRIS			DATE RECEIVED:	01/03/05
COMMODITY:	River Water			DATE REPORTED:	02/04/05
				DANR CLIENT #:	SCHS1
				TURN AROUND TIME IN WORKING DAYS:	24

Sample Type: WATER Date Sampled: 12/31/04

SAMPLE #	DESC	TSS [SOP 870] mg/L	Turbidity [SOP 810] NTU
1	RB	282	442
1 dup	RB	NES	430
2	RB	282	432
3	CB	218	330
4	CB	198	337
5	EB	200	328
6	EB	196	339
7	Rd 89	232	343
8	Rd 89	206	338
9	Rd 94B	256	377
10	Rd 94B	260	400
10 dup	Rd 94B	NES	404
11	Rd 99W	442	685
12	Rd 99W	446	700
12 dup	Rd 99W	NES	704
Method Detection Limit:		4	0.1
Blank Concentration:		0	0
Standard Ref as Tested:		127	210
Standard Ref Acceptable:		120±14	200±20
Standard Reference:		SOLIDSB	200 NTU

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Rani Singh, Chemist

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