Moody Creek Monitoring Report 2003

Developed for:

Madison Soil and Water Conservation District
Idaho Soil Conservation Commission
Idaho State Department of Agriculture

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Technical Results Summary CFF-Mdy-01

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Acknowledgements

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Executive Summary

Moody Creek is located in the Teton River subbasin, HUC# 17040204, which is a tributary to the Henry's Fork of the Snake River. Several tributaries in the Teton River subbasin are listed on the state of Idaho's §303(d) list for having water quality limited segments. Moody Creek is the only tributary that is listed for nutrients.

Idaho Association of Soil Conservation Districts began water quality monitoring on Moody Creek on April 18, 2001. The data included in this report goes through July 31, 2003. Sampling was performed on three sites during 2001 with an additional site near the headwaters in the spring of 2002. These sites were monitored twice a month, April through October, and once a month November through March. Some of the sites were inaccessible during adverse weather conditions.

All monitoring sites were sampled for total suspended solids, total volatile solids, total phosphorus, ortho-phosphorus, nitrate + nitrite and ammonia. Dissolved oxygen, water temperature, specific conductance, total dissolved solids, pH and stream flow were measured in the field.

Sediment and total phosphorus concentrations appear to increase in the creek during spring runoff. The mean concentration levels for total suspended solids and total phosphorus tend not to exceed the targets set by the Idaho Department of Environmental Quality. There are specific dates that do exceed the targets, but these were primarily during spring runoff.

The mean concentrations for nitrate + nitrite exceed the 0.30 mg/L target at all monitoring sites. During the 2001 sampling year, very little nitrate + nitrite was detected in any samples. Starting in 2002, the concentrations were three times the target. This trend continued in 2003. This needs to be further investigated through monitoring. Meeting with other agencies will be done to determine if some event happened in 2001 or 2002 to change the nitrate + nitrite concentrations drastically.

Introduction

The Idaho Association of Soil Conservation Districts (IASCD) monitored several sites located on Moody Creek in Madison County. Monitoring began April 2001 and will continue through April 2004. The project was to provide water quality data to the Madison Soil and Water Conservation District (SWCD) in determining pollutant loads on Moody Creek based on the Teton River Total Maximum Daily Load (TMDL). The data will be used to plan implementation of voluntary agricultural best management practices (BMP) throughout the Moody Creek subwatershed. IASCD has worked cooperatively with Idaho State Department of Agriculture (ISDA), Madison SWCD and Natural Resources Conservation Service (NRCS) to implement this project. Moody Creek is listed on the state of Idaho's §303(d) list for being water quality limited.

Subwatershed Description

Moody Creek is located in the Teton River subbasin, hydrologic unit code (HUC) #17040204. The subwatershed is located in eastern Idaho and is a tributary to the South Fork of the Teton River. The South Fork of the Teton River enters the Henry's Fork of the Snake River approximately 12 miles below the confluence with Moody Creek. The Moody Creek subwatershed (Figure 1) is located in the western section of the Teton River subbasin. The subbasin follows the Fremont, Madison and Teton county lines.

Moody Creek originates in the Targhee National Forest (TNF), in the Big Hole Mountains. Several tributaries, including North and South Moody, Browning, Garner and Fish creeks flow together to form Moody Creek. Moody Creek, below the TNF boundary, is a third order stream. Several small, unnamed streams and springs enter Moody Creek below the TNF boundary. Below the forest, Moody Creek flows through a few miles of state land before entering private land. Approximately 20 miles after leaving forestland, Moody Creek enters the South Fork of the Teton River. The primary land uses in the subbasin are agriculture and recreation (IDEQ, 2002). Approximately 73% of Madison County and 67% of Teton County is private land. Federally managed land makes up 20% in Madison County and 33% in Teton County. The state of Idaho manages land in seven percent of Madison County, and about one percent of Teton County, approximately.

There is one dam located on Moody Creek. Webster Dam was built around 1900 to aid in irrigation and is located on state land that is managed by Idaho Department of Lands (IDL) (IDEQ, 2002). It is currently filled in with sediment and acts as a fish barrier.

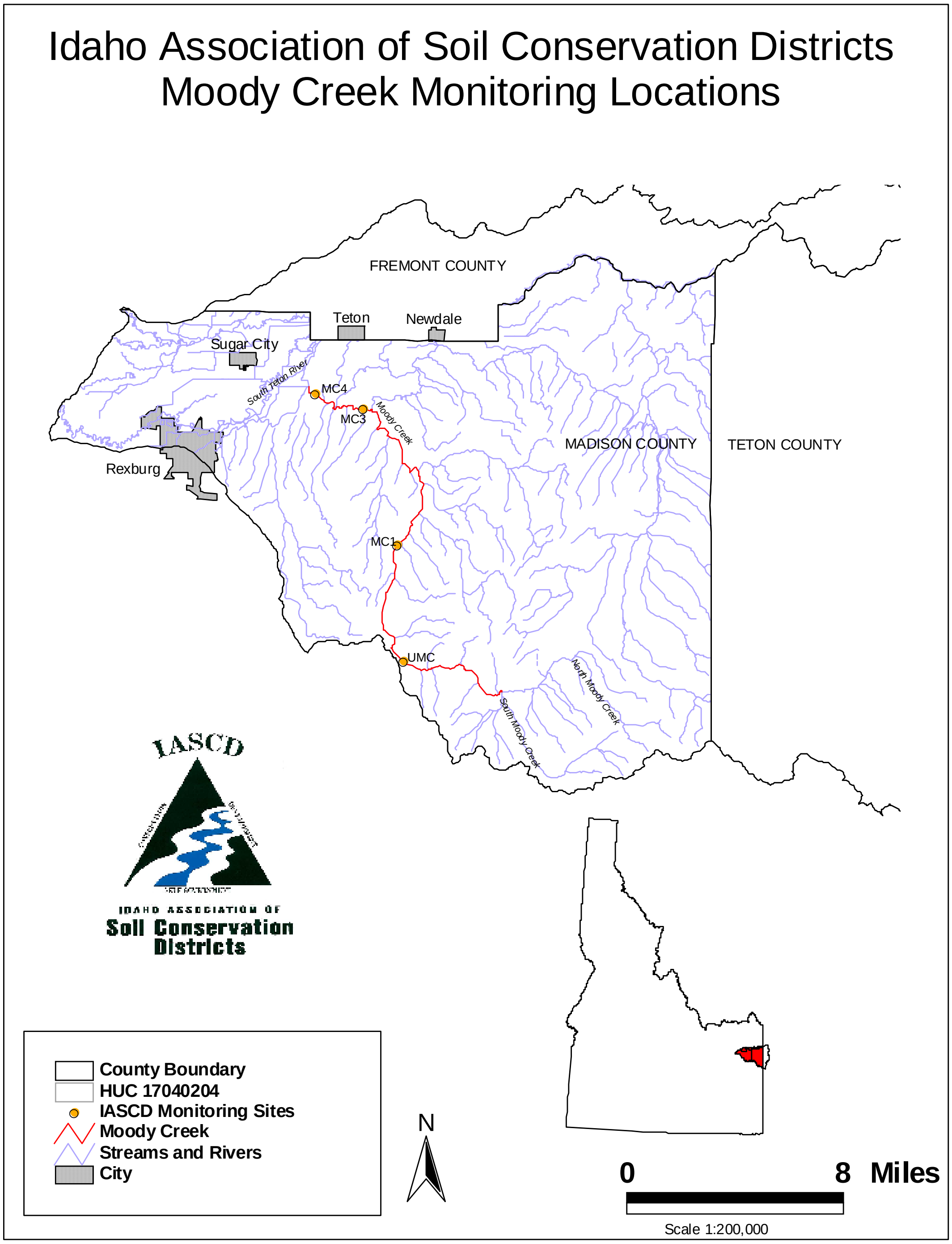

Figure 1. Moody Creek and IASCD monitoring site locations.

The Teton River TMDL

The Teton River TMDL was written by the Idaho Department of Environmental Quality (IDEQ) and submitted to the Environmental Protection Agency (EPA) in August 2003 for approval. There are 13 water quality limited segments located in the Teton Subbasin. The Teton River is divided into four segments and is listed for nutrients, sediment and habitat alteration (IDEQ, 1998). Moody Creek is the only tributary listed for nutrients. Badger, Spring, South Leigh, Packsaddle, Darby and Fox creeks are listed for sediment. Spring, Packsaddle, Horseshoe, Darby and Fox creeks are listed for flow alteration. Spring and Fox creeks are listed for temperature and North Leigh Creek is on the §303(d) list, but the pollutant is unknown.

Table 1. Pollutant targets for §303(d) listed segments in the Teton River TMDL.

Pollutant of Concern	Proposed Pollutant Targets for Teton TMDL
Total Suspended Solids	Not to exceed 80 mg/L, regardless of season
Total Nitrate + Nitrite	Not to exceed 0.30 mg/L
Total Phosphorus	Not to exceed 0.10 mg/L

Monitoring Site Locations

Starting in April 2001, three locations were established on Moody Creek for water quality monitoring. An additional monitoring site, UMC, was added during April 2002 and was located approximately three miles downstream of TNF boundary and almost one mile downstream of state land (Figure 1). This upper Moody Creek site was monitored four times during the 2002 season with continued monitoring throughout the 2003 monitoring season. Station UMC is not accessible in winter or during adverse weather conditions.

The lowest monitoring site, MC4, is located upstream of Moody Creek Road, directly above where the creek crosses the road. This site is accessible year round if it is not iced over in the winter. MC4 is the only monitoring site that is not located in Moody Creek Canyon. The next site MC3 is located on the upstream side of Pincock Road. It is located on the upstream side of the road. This site is also accessible throughout the year. MC1 is located on the downstream side of the bridge at Wood’s Crossing and at times this site is difficult to access due to steep terrain.

Project Objectives

The project scope of work was discussed and approved by representatives of Madison SWCD, ISDA, NRCS and IDEQ. IASCD worked cooperatively with these agencies in an attempt to complete the following objectives:

- Evaluate the impact of agricultural activities and range land on Moody Creek.
- Evaluate the water quality and discharge rates within Moody Creek below the TNF boundary.
- Identify areas of concern for implementation of best management practices.
- Use this data to increase public awareness.

Methods

Sampling Schedule and Parameters

Sampling of Moody Creek began on April 18, 2001. The data included in this report goes through July 31, 2003. Sampling was performed twice a month from April through October and monthly November through March. The sites all freeze over during the winter months, so samples were not collected.

Samples were collected and field measurements taken for the parameters listed in Table 2. Samples were delivered to IAS-EnviroChem Laboratory in Pocatello, Idaho within the appropriate holding times.

Table 2. Water Quality Parameters and Field Measurements

Water Quality Parameters	**Laboratory Method**
Total suspended solids (TSS)	EPA 160.2
Total volatile solids (TVS)	EPA 160.4
Total phosphorus	EPA 365.4
Ortho phosphorus	EPA 365.2
Nitrate	EPA 300
Nitrite	EPA 300
Ammonia	EPA 350.3
Field Measurements	**Instrument**
Dissolved oxygen	YSI Model 55
Water temperature	YSI Model 55
Conductivity	Orion Model 115
Total dissolved solids	Orion Model 115
pH	Corning 313
Stream flow	Marsh McBirney Flo-Mate Model 2000

Sampling Methods

Sample collection techniques followed approved United State Geological Survey (USGS) methods (Shelton, 1994). All analytical testing followed either EPA or Standard Methods for the Examination of Water and Wastewater approved methods. Quality control samples, duplicates and blanks, comprised at least 10% of the sample load during this program. Quality Assurance and Quality Control (QA/QC) results are in Appendix A. Duplicate and blank samples were stored and delivered with the normal sample load for analytical testing. For project tracking, chain-of-custody protocols were followed for all sample handling.

A comparison of the mean and standard deviation for duplicate samples are shown in Appendix A, Table 5. Results from the calculated relative percent difference (RPD) for the duplicates are also in Appendix A, Table 6.

Flow Measurements

Flow measurements were collected with a Marsh McBirney Flo-Mate Model 2000 flow meter. The six-tenth-depth method (0.6 of the total depth below water surface) was used when the depth of water was less than or equal to three feet. When the water was over three feet deep, an average of the two-tenth and eight-tenth-depth method (0.2 and 0.8 of the total depth below water surface) was measured. A transect line was set up perpendicular to flow across the width of each creek and the mid-section method for computing cross-sectional area along with the velocity-area method was used for discharge determination. The discharge was computed by summation of the products of the partial areas of the flow cross-sections and the average velocities for each of those sections.

Water Quality

Samples for water quality analysis were collected by grab sampling directly from the stream on wadable sites. For shallower sites (<1 ft) grab samples were collected by hand using a clean one-liter stainless steel container. A DH-81 integrated sampler was used at wadable sites with water depths greater than 1 foot. For each method, individual samples were collected at equal intervals across the entire width of the stream. Each discrete sample was composited in a 2.5 gallon polyethylene churn sample splitter from which homogenized samples were poured off into sample containers.

Field Measurements

Field measurements for dissolved oxygen, percent saturation and water temperature were taken directly in the streams from well-mixed sections, near mid-stream at approximately mid-depth. Measurements for specific conductance, pH and dissolved solids were taken from the churn splitter composite sample, immediately following collection. Calibration of all field equipment was in accordance with the manufactures specifications. All field measurements were recorded in a bound logbook along with pertinent observations about the site, including weather conditions, flow rates and personnel on site.

Data Handling

The field data and analytical data generated from each survey were reviewed by IASCD and ISDA personnel. Each batch of data was reviewed to insure that all observations, measurements and analytical results have been properly recorded. The analytical results were evaluated for completeness and accuracy. Any suspected errors were investigated and resolved, if possible. The data was then stored electronically and made available to any interested entity.

Results and Discussion

Moody Creek is listed on the 1998 §303(d) as having nutrients as a pollutant of concern. Nutrients are measured as nitrate + nitrite (NO_3+NO_2) and total phosphorus (TP). In addition to NO_3+NO_2 and TP, ammonia (NH_3) and ortho phosphorus (OP) were measured. Sediment was measured as total suspended solids (TSS). The mean concentrations for TSS, NO_3+NO_2, TP and discharge (Q) are summarized in Table 3.

Table 3. Mean Values from April 2001 through July 2003 Water Quality Data

Site	**TSS** mg/L	**NO_3+NO_2** mg/L	**TP** mg/L	**Q** cfs	**n**
MC4	33.4	0.42	0.07	14.8	39
MC3	51.7	0.36	0.08	13.4	33
MC1	28.3	0.38	0.08	10.0	31
UMC	18.0	0.77	0.05	16.9	10

Stream Discharge

During 2001, MC1, MC3 and MC4 all experienced at least one period where there was no discharge. MC4 and MC3 had discharge throughout the 2002 and 2003 sampling seasons. During a tour of the subwatershed in September 2003, the comment was made by a landowner that the creek did dry up completely at least once during the 2003 summer. IASCD did not observe dry stream conditions at sites MC3 and MC4 during the sampling dates. At times; during the 2001, 2002 and 2003 seasons, the discharge rate at MC1 was insufficient to allow sample collection.

When comparing years, there was an increase in the total discharge at MC1 and MC4 during the 2002 sampling season. Total discharge at MC1 for 2001 was 71.2 cfs, 2002 was 166 cfs and 2003 was 59.2 cfs. Total discharge at MC4 for 2001 was 104 cfs, 2002 was 274 cfs and 2003 was 158 cfs (Figure 2). The total discharge was not calculated for the entire 2003 sampling season since the data is only reported through July 31, 2003.

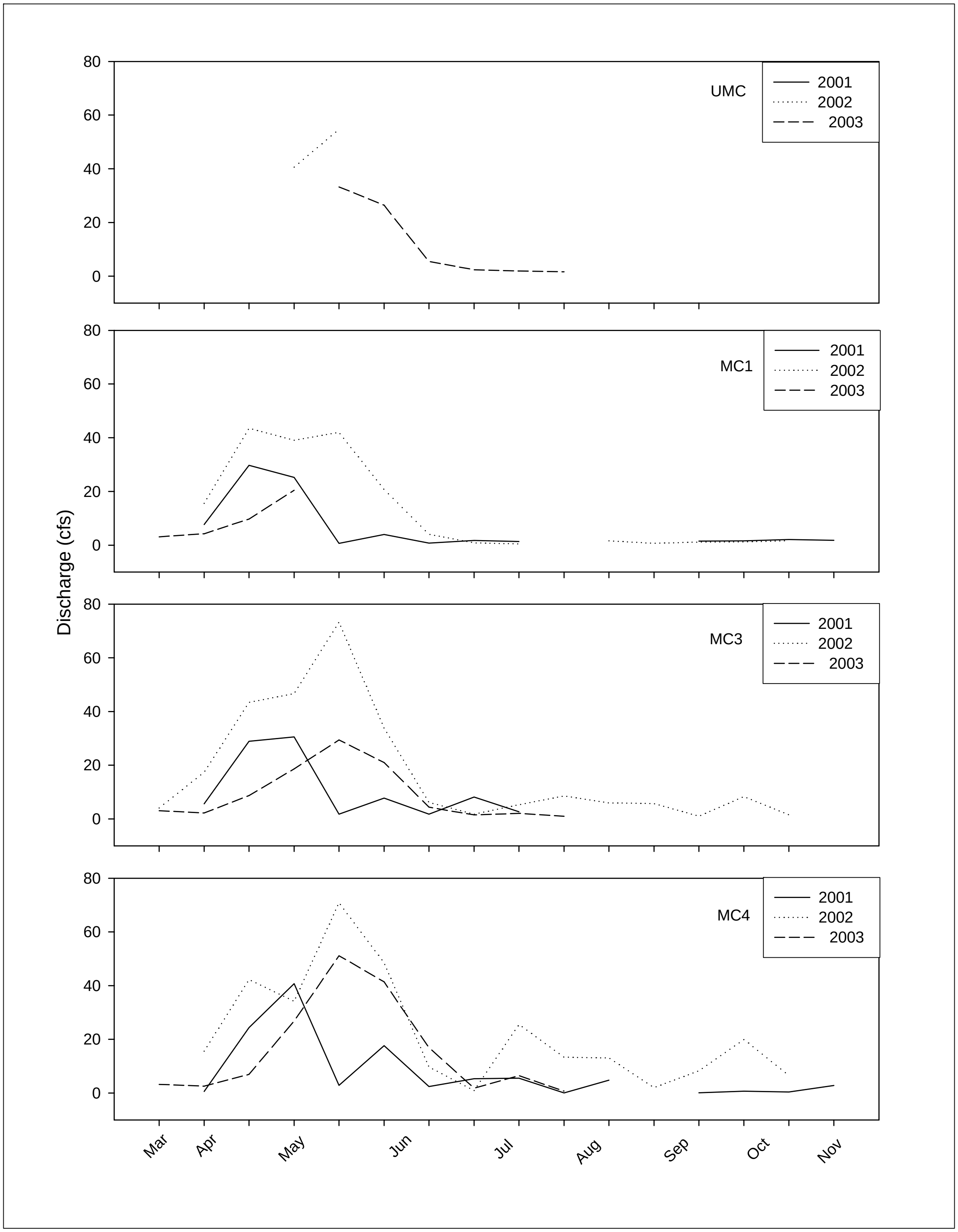

Figure 2. Discharge measurements for Moody Creek monitoring sites.

Flows typically peak in May and then return to a base flow in mid June. The streams are either filled in with snow or are frozen during the winter months. With the exception of station MC4, no samples were collected between mid November and mid March. During January 2003, a rain on snow event occurred where one sample was collected at MC4 to analyze runoff.

Total Suspended Solids

Moody Creek is one of the water quality limited segments in the Teton River subbasin that is not listed for sediment. TSS samples were collected at the Moody Creek monitoring sites to determine if there was a sediment problem. The proposed TMDL target for TSS shall not exceed 80 mg/L regardless of season (IDEQ, 2002).

None of the sites exceeded 80 mg/L when the TSS concentrations were averaged for the entire sampling period (Table 3). During base flow periods, TSS concentrations were typically below 50 mg/L. During spring runoff, levels of TSS exceeded the 80 mg/L target. Only UMC did not exceed the 80 mg/L target, but this could be due to inaccessibility during spring runoff (Figure 2).

Webster Dam, which is located upstream of station UMC, acts as a fish barrier and has high amounts of sediment located in it. In the event of major runoff from the TNF, some of the sediment trapped behind the dam could be flushed downstream. In addition to Webster Dam, there are several beaver dams in Moody Creek. These dams act as traps for suspended solids traveling downstream. During spring runoff, suspended solids are traveling at a higher velocity and would not typically have time to settle out. Some spring runoff events may even result in such high water velocities that the beaver dams are removed by the force of the water. The dam removal would occur typically during a more normal or above normal water year. The data provided for this report have been taken during drought years.

Moody Creek acts as a transport system for irrigation water. Water from the Teton River is brought into the creek through several canals. Enterprise Canal enters the creek above MC3. East Teton and Teton canals enter Moody Creek between the MC4 and MC3 monitoring sites. Below MC4, the Woodmansee Johnson Canal enters Moody Creek. Approximately two miles downstream, is the confluence of Moody Creek with the South Fork of the Teton River.

There are several steep and cut banks that have the potential to introduce sediment into the creek during a higher water year. Natural processes of stream flow and snow melt have had impact on stream banks in the subwatershed. In some areas where there is no grazing, the stream banks are vertical and vegetated but still are sloughing into the creek. Grazing has impacted Moody Creek in some isolated areas resulting in bank erosion and sloughing. Even with these streambanks eroding and sloughing, TSS levels are relatively low in the subwatershed.

Other sources of sediment in Moody creek could come from roads and recreation. Several roads traveled by IASCD to the monitoring sites are dirt and gravel. Most of these roads do not directly parallel Moody Creek, but they do cross the creek several times. Fishing, camping and off-road vehicles have the potential to impact the creek on private, state and federal lands. These activities could result in additional sediment being introduced into the creek.

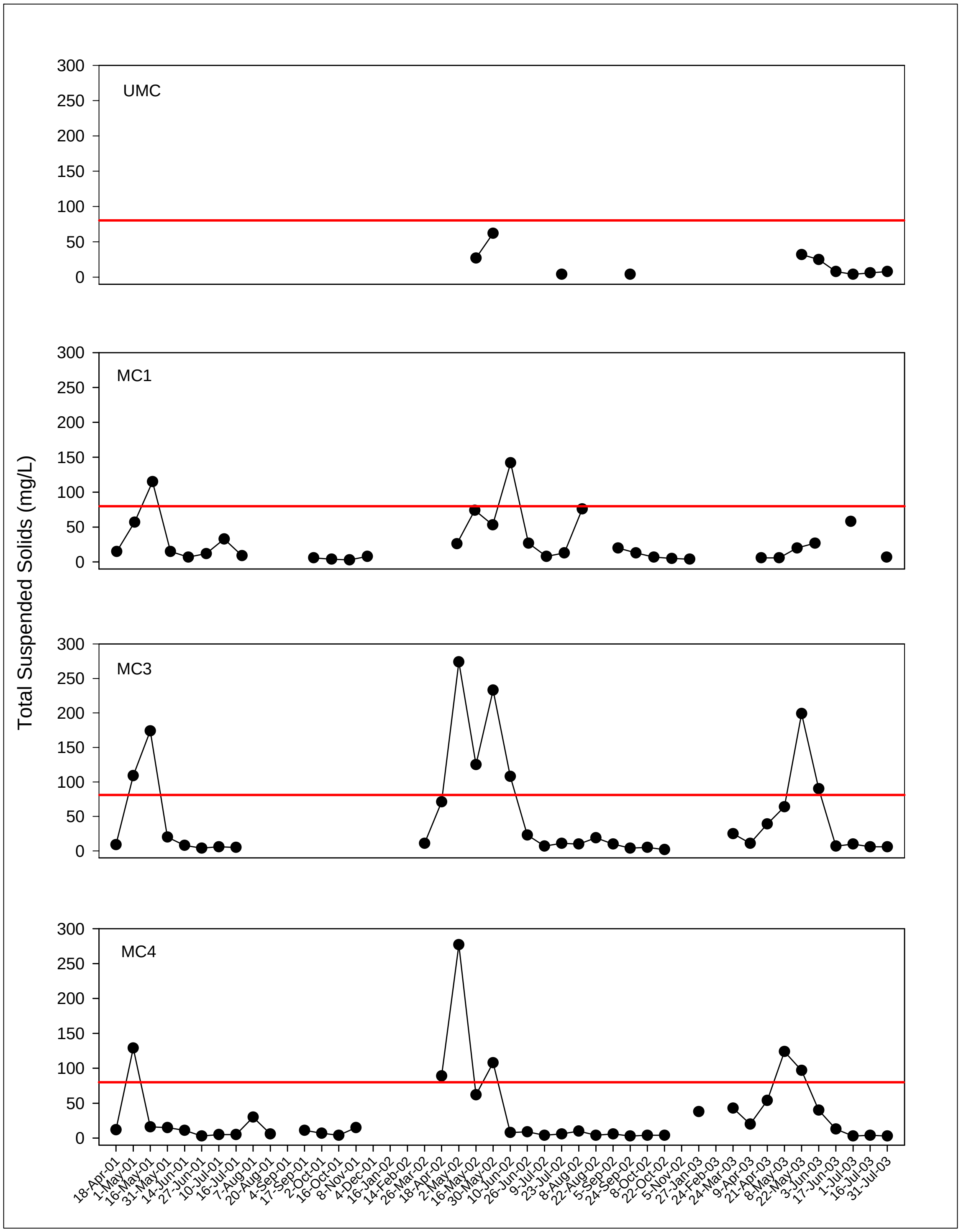

Figure 3. Total suspended solid concentrations for Moody Creek monitoring sites. The red line indicates the 80 mg/L target.

Nitrate + Nitrite

Nutrients are the only pollutant that Moody Creek is listed for on the state of Idaho's §303(d) list. The mean NO_3+NO_2 concentration for all the monitoring sites is over the TMDL target of 0.30 mg/L (Table 3). Monitoring site UMC, which is located below public lands, had the highest concentration of 0.77 mg/L. MC3 and MC1 are above the target with 0.36 and 0.38 mg/L respectively and MC4 exceeds the target at 0.42 mg/L. Refer to Figure 4 for graphs of the seasonal concentrations of NO_3+NO_2.

The mean concentrations in Table 4 are taken over the entire data set. Concentrations of NO_3+NO_2 were well below the target, and almost always undetectable in the laboratory, during the first year of monitoring. During 2002, mean concentrations of NO_3+NO_2 increased at monitoring sites MC1, MC3 and MC4. The highest mean concentration still remains at the upper most site, UMC.

Table 4. Mean values of NO_3+NO_2 during entire data set and excluding 2001 data.

Site	**NO_3+NO_2** mg/L	**NO_3+NO_2 without 2001** mg/L
MC4	0.42	0.61
MC3	0.36	0.47
MC1	0.38	0.61
UMC	0.77	0.77

The source of nitrogen is difficult to pinpoint. Nitrogen can come from precipitation that has fallen directly onto the stream surface, fixation in the water and sediments and input from surface and groundwater (Wetzel, 1983). Wetzel also notes that snow, rather than rain, contains a higher content of nitrogen, and could contribute up to half the total influx during a year.

Ground water could be a contributor of NO_3+NO_2 into the surface water. Moody Creek has several smaller tributaries that flow from springs. Fertilizer and decomposed manure or plant residue can leach into the ground water over time, or runoff directly into the river or creeks during a rainstorm or spring runoff. Some plant residue can cause elevated levels of nutrients in the water. During the winter, aquatic plants may decompose elevating the NO_3+NO_2 concentrations.

The concentrations of NO_3+NO_2, on Moody Creek, have no particular pattern throughout the years and sites. UMC, MC1 and MC4 typically have higher amounts of aquatic growth in the stream channel during low flow and summer months. The substrate for UMC and MC4 is more of a gravel and small cobble substrate while MC1 has more silt than the other sites. MC3 has very little algae and its substrate is composed of small gravel and sand that moves more easily than the substrates of the other monitoring sites. This substrate may not be a good anchor for algae and therefore, the growth does not occur. The increased aquatic growth may be a contributor to the higher NO_3+NO_2

concentrations. The site with the least amount of algae, MC3 has the lowest NO_3+NO_2 concentration.

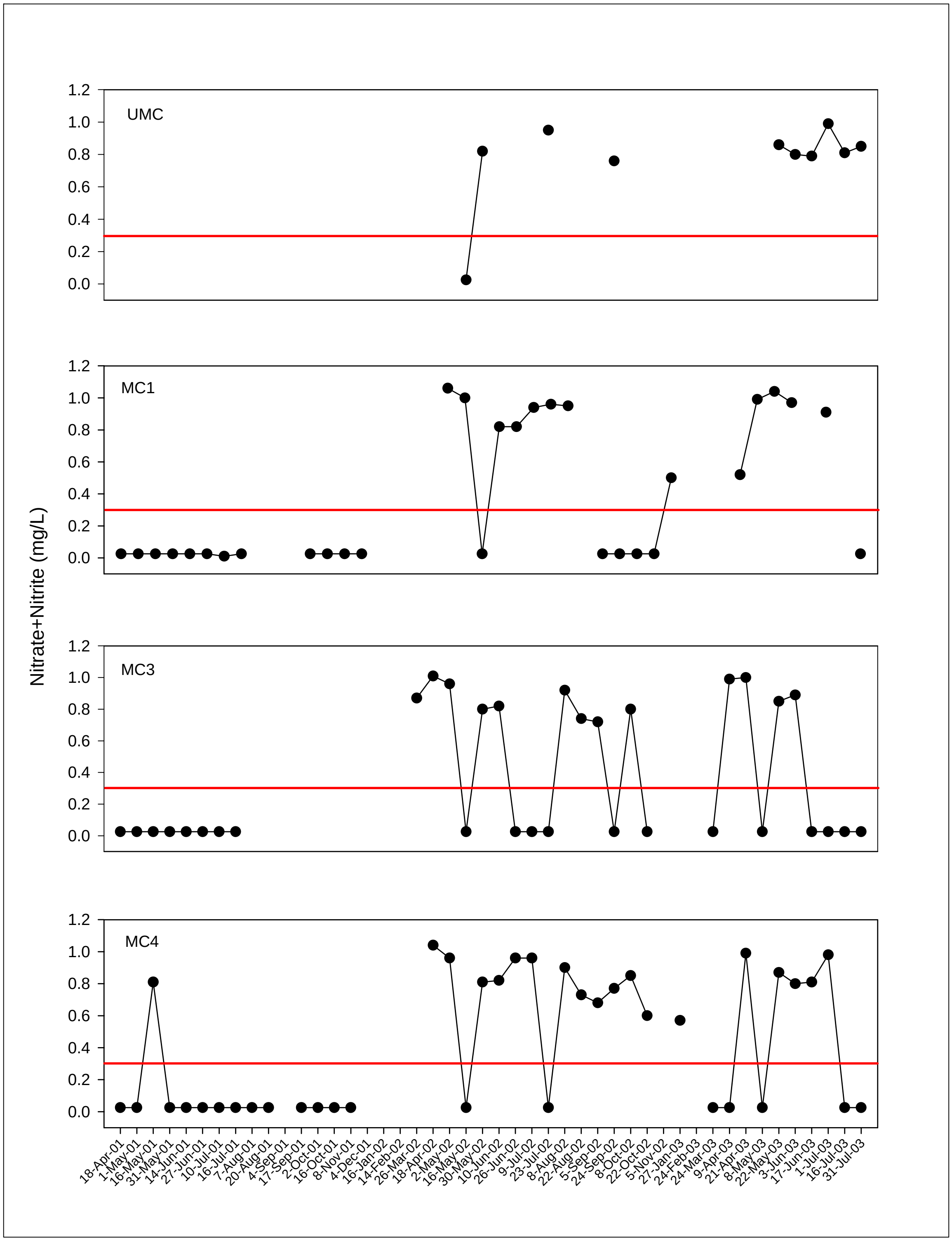

Figure 4. Nitrate + Nitrite concentrations for Moody Creek monitoring sites. The red line indicates the 0.30 mg/L target.

Total Phosphorus

Total phosphorus (TP) is also a nutrient that is listed as a pollutant of concern for Moody Creek. The TMDL target for TP is 0.10 mg/L based on the EPA Gold Book Criteria (USEPA, 1987). All four sites are below the 0.10 mg/L target for the mean concentrations (Table 3). There is a seasonal variation for TP which is illustrated in Figure 5. For monitoring sites MC3 and MC4, TP is transported during spring runoff. MC1 tends to have fluctuations of TP throughout the monitoring season. This could be the result of water being taken out of Moody Creek for irrigation then being turned back into the creek. There is also a beaver dam located upstream of MC1 that could effect TP and sediment concentrations based on activities at the dam.

Phosphorus, in a particulate form, will adhere to sediment particles and travel with the sediment. A good correlation ($R^2 = 0.85$) between TSS and TP was found at MC3 using a simple regression. This correlation indicates that phosphorus is being mobilized with sediment. Two other sites showed weaker correlations; MC1 ($R^2 = 0.48$) and MC4 ($R^2 = 0.50$), and UMC showed no correlation ($R^2 = 0.27$). The poor correlation at UMC could be the result of insufficient data points.

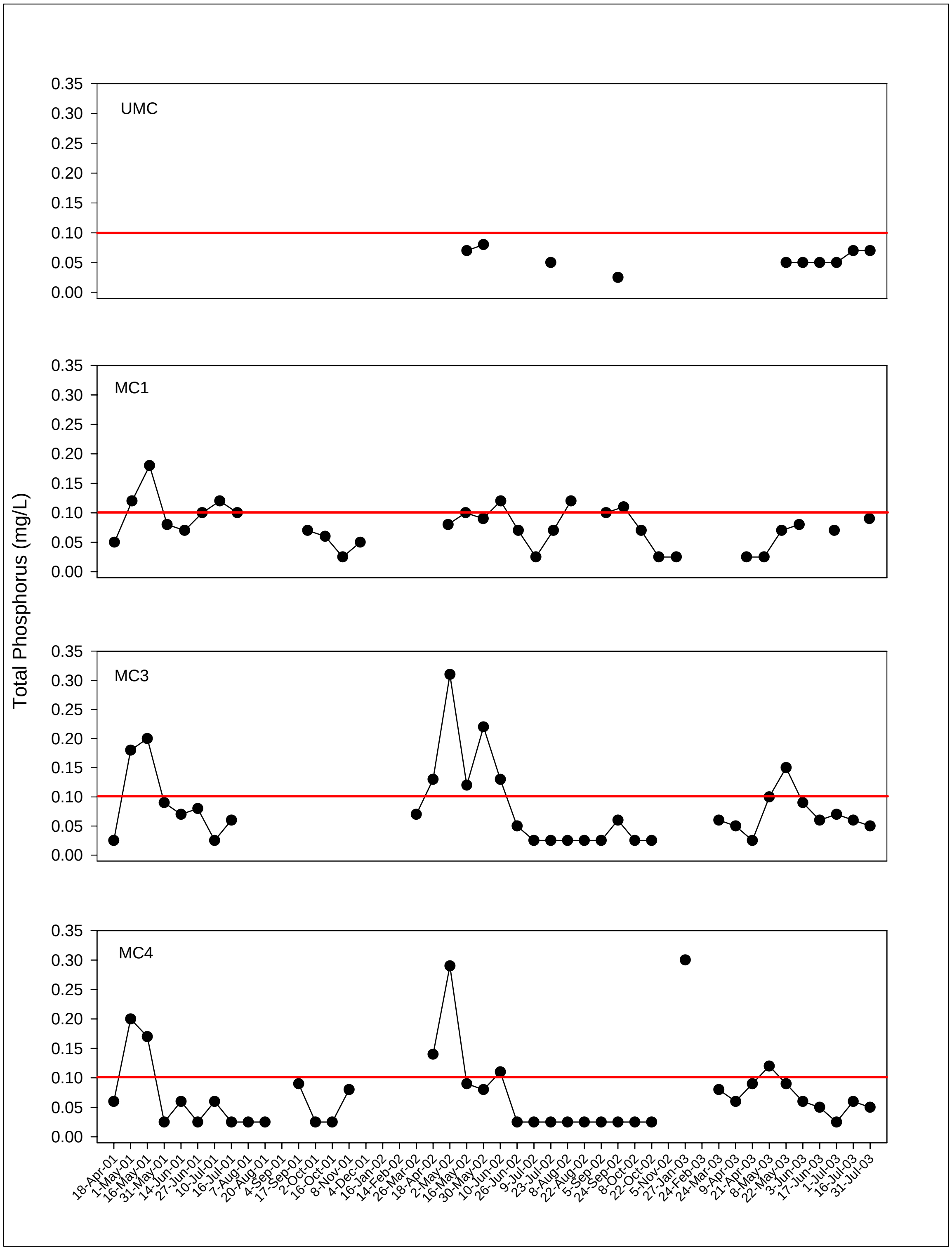

Figure 5. Total phosphorus concentrations for Moody Creek monitoring sites. The red line indicates the 0.10 mg/L target.

Conclusions

Sediment appears to become mobilized during spring runoff. Peak concentrations of TSS occurred in the spring. Large amounts of TSS (277 mg/L) move during spring runoff events, but the mean concentrations for the sampling period remain below the 80 mg/L. Webster Dam may contribute to the increase of sediment when there is runoff from the TNF.

It is difficult to determine the NO_3+NO_2 source. It fluctuates throughout the monitoring season. It may be naturally occurring, in the form of precipitation or transported from runoff or snowmelt. It may also be a result of decomposing organic matter, aquatic vegetation or occur naturally in ground water. The increase in discharge during the 2002 season could have increased the concentration of NO_3+NO_2. This source could also be from an increase in discharge of the springs in the headwaters of Moody Creek.

Mean concentrations for TP, over sampling period, did not exceed the TMDL proposed concentration 0.10 mg/L. Individual sampling events did exceed the 0.10 mg/L level, primarily during runoff events, at all stations except UMC. Beaver activity and irrigation practices may increase the nutrient levels in Moody Creek.

Recommendations

The following recommendations should be considered:

- Collection of additional data to evaluate the nitrogen concentrations and sources due to the variability in the NO_3+NO_2 numbers from 2001 to the 2002 monitoring,
- Monitoring of springs that feed Moody Creek may be valuable in evaluating nitrogen concentrations.
- Evaluation of the TNF and state land above station UMC may reveal sources of nitrogen entering Moody Creek.
- Evaluation of stream bank conditions for severe down cutting, sloughing and loss of riparian function that may contribute phosphorus and sediment during high water conditions.
- Evaluation of irrigation water return systems to determine which ones, if any are causing impacts to the water quality of Moody Creek.
- Assessment of any impact that animal grazing activities may have on the functioning condition of Moody Creek’s riparian area.
- Identification of critical areas or critical activities that would best be addressed by implementation of BMPs.
- The SCD, NRCS, IASCD, ISCC and ISDA to work with landowners and cooperators to fund and implement projects that will improve the overall water quality of Moody Creek.

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Appendix A
Quality Control Results

Quality Assurance/Quality Control (QA/QC)

The QA/QC procedure for this monitoring program conformed to those outlined in the "Water Quality Sampling Plan", prepared by the IASCD.

Intermountain Analytical Services- EnviroChem utilized EPA approved and validated methods. Method performance evaluations include quality control samples analyzed with a batch to ensure sample data integrity. Internal laboratory spikes and duplicates are all part of EnviroChem's quality assurance program.

Field QA/QC protocols consisted of duplicate samples and blank samples. The field blanks consisted of laboratory grade deionized water, transported to the field, and poured off into properly prepared sample containers. For filtered constituents, deionized water was transferred into the filtration unit, filtered, and the resultant filtrate was transferred into appropriate sample containers. The blank samples were used to determine the integrity of the field teams sampling handling, the cleanliness of the sample containers, and the accuracy of the laboratory methods. There were no constituents detected (above the method detection limits) for any of the blank samples submitted during this program.

The duplicate samples consisted of two sets of sample containers filled (in the field) with the same composite water from the same sampling site. The duplicate samples were not identified as such and entered the laboratory as blind duplicates. The duplicate samples were used to determine both field and laboratory precision. All of the QC samples were stored on ice and handled with the normal sample load for shipment to the laboratory.

Table 5. Duplicate Comparison, Mean and Standard Deviation

Parameters	MC4 Mean	Duplicate Mean	MC4 Standard Deviation	Duplicate Standard Deviation
TSS	35.2	35.1	53.3	52.8
TVS	4.26	4.11	4.71	4.30
Nitrate+Nitrite	0.42	0.42	0.42	0.42
Ammonia	0.04	0.04	0.03	0.03
Total Phosphorus	0.08	0.08	0.06	0.07
Ortho-Phosphorus	0.04	0.04	0.04	0.04

Precision

Relative percent difference (RPD) is the normal measure of precision when calculated from duplicate sample. As previously mentioned, the duplicates were collected in the field. The calculation for RPD is as follows:

$$RPD = \frac{(C_1-C_2)*100}{(C_1+C_2)/2}$$

Where: RPD = relative percent difference
C_1 = Larger of the two observed values
C_2 = Smaller of the two observed values

Minnesota Pollution Control Agency (1998) recommends an RPD should have a value of less than 25% for water samples.

Table 6. Relative Percent Differences (duplicates)

Date	Original NO_3+NO_2	Duplicate NO_3+NO_2	RPD	Original TSS	Duplicate TSS	RPD	Original TVS	Duplicate TVS	RPD
18-Apr-01	0.025	0.025	0	15	13	14	2	3	40
1-May-01	0.025	0.025	0	57	57	0	8	8	0
16-May-01	0.025	0.025	0	115	123	7	15	16	6
31-May-01	0.025	0.025	0	15	17	13	4	4	0
14-Jun-01	0.025	0.025	0	7	7	0	1	1	0
27-Jun-01	0.025	0.025	0	12	13	8	2	1	67
10-Jul-01	0.01	0.025	85	33	29	13	5	6	18
16-Jul-01	0.025	0.025	0	9	10	11	2	1	67
7-Aug-01									
20-Aug-01	0.025	0.025	0	6	5	18	2	2	0
4-Sep-01									
17-Sep-01	0.025	0.025	0	11	12	9	2	3	40
2-Oct-01	0.025	0.025	0	7	8	13	1	1	0
16-Oct-01	0.025	0.025	0	4	4	0	1	1	0
8-Nov-01	0.025	0.025	0	15	15	0	3	3	0
4-Dec-01									
16-Jan-02	0.83	0.79	5.7						
14-Feb-02									
26-Mar-02									
18-Apr-02	1.04	1.03	1	89	82	8	8	8	0
2-May-02	0.96	0.97	1	277	270	3	24	20	18
16-May-02	0.025	0.025	0	62	62	0	6	6	0
30-May-02	0.81	0.81	0	108	107	1	11	10	10
10-Jun-02	0.82	0.83	1	8	8	0	8	7	13
26-Jun-02	0.96	0.96	0	9	9	0	1	1	0
9-Jul-02	0.96	0.97	1	4	4	0	1	1	0
23-Jul-02	0.025	0.025	0	6	7	15	2	1	67
8-Aug-02	0.9	0.91	1	10	9	11	2	2	0
22-Aug-02	0.73	0.73	0	4	4	0	1	1	0
5-Sep-02	0.68	0.68	0	6	6	0	1	1	0
24-Sep-02	0.77	0.77	0	3	3	0	1	1	0
8-Oct-02	0.85	0.83	2	4	3	29	1	1	0
22-Oct-02	0.6	0.59	2	4	4	0	1	1	0
5-Nov-02									
27-Jan-03	0.57	0.58	2	38	39	2	6	6	0
24-Feb-03									
24-Mar-03	0.025	0.025	0	43	44	2	5	5	0
9-Apr-03	0.025	0.025	0	20	20	0	3	3	0
21-Apr-03	0.99	1	1	54	53	2	5	5	0
8-May-03	0.025	0.025	0	124	131	5	9	8	12
22-May-03	0.87	0.87	0	97	92	5	8	8	0
3-Jun-03	0.8	0.79	1	40	40	0	5	5	0
17-Jun-03	0.81	0.79	03	13	14	7	2	2	0
1-Jul-03	0.98	0.98	0	3	3	0	1	1	0
16-Jul-03	0.025	0.025	0	4	5	22	1	1	0
31-Jul-03	0.025	0.025	0	3	3	0	1	1	0

Table 6 con't. Relative Percent Differences (duplicates)

Date	Original TP	Duplicate TP	RPD	Original OP	Duplicate OP	RPD	Original NH_3	Duplicate NH_3	RPD
18-Apr-01	0.05	0.06	18	0.025	0.025	0	0.025	0.06	82
1-May-01	0.12	0.13	8	0.025	0.025	0	0.025	0.025	0
16-May-01	0.18	0.18	0	0.025	0.025	0	0.06	0.1	50
31-May-01	0.08	0.09	12	0.025	0.025	0	0.06	0.08	28
14-Jun-01	0.07	0.07	0	0.025	0.025	0	0.025	0.025	0
27-Jun-01	0.1	0.1	0	0.06	0.06	0	0.025	0.06	82
10-Jul-01	0.12	0.13	8	0.09	0.09	0	0.07	0.1	35
16-Jul-01	0.1	0.1	0	0.07	0.07	0	0.025	0.025	0
7-Aug-01									
20-Aug-01	0.025	0.025	0	0.025	0.025	0	0.025	0.025	0
4-Sep-01									
17-Sep-01	0.09	0.07	25	0.025	0.025	0	0.1	0.1	0
2-Oct-01	0.025	0.06	82	0.025	0.025	0	0.025	0.025	0
16-Oct-01	0.025	0.025	0	0.025	0.025	0	0.025	0.025	0
8-Nov-01	0.08	0.08	0	0.025	0.025	0	0.025	0.025	0
4-Dec-01									
16-Jan-02									
14-Feb-02									
26-Mar-02									
18-Apr-02	0.14	0.15	7	0.025	0.025	0	0.05	0.025	67
2-May-02	0.29	0.31	7	0.025	0.025	0	0.05	0.05	0
16-May-02	0.09	0.1	11	0.025	0.025	0	0.025	0.025	0
30-May-02	0.08	0.1	22	0.025	0.025	0	0.025	0.025	0
10-Jun-02	0.11	0.11	0	0.025	0.025	0	0.025	0.025	0
26-Jun-02	0.025	0.025	0	0.025	0.025	0	0.025	0.025	0
9-Jul-02	0.025	0.025	0	0.025	0.025	0	0.025	0.025	0
23-Jul-02	0.025	0.025	0	0.025	0.025	0	0.025	0.025	0
8-Aug-02	0.025	0.025	0	0.025	0.025	0	0.025	0.025	0
22-Aug-02	0.025	0.025	0	0.025	0.025	0	0.025	0.025	0
5-Sep-02	0.025	0.05	67	0.025	0.025	0	0.025	0.025	0
24-Sep-02	0.025	0.025	0	0.025	0.025	0	0.025	0.025	0
8-Oct-02	0.025	0.025	0	0.025	0.025	0	0.025	0.025	0
22-Oct-02	0.025	0.025	0	0.025	0.025	0	0.025	0.025	0
5-Nov-02									
27-Jan-03	0.30	0.32	6	0.26	0.26	0	0.08	0.07	13
24-Feb-03									
24-Mar-03	0.08	0.08	0	0.025	0.025	0	0.025	0.025	0
9-Apr-03	0.06	0.05	18	0.025	0.025	0	0.025	0.025	0
21-Apr-03	0.09	0.08	12	0.025	0.025	0	0.13	0.13	0
8-May-03	0.12	0.12	0	0.025	0.025	0	0.025	0.025	0
22-May-03	0.09	0.09	0	0.025	0.025	0	0.09	0.09	0
3-Jun-03	0.06	0.06	0	0.025	0.025	0	0.025	0.025	0
17-Jun-03	0.05	0.05	0	0.025	0.025	0	0.025	0.025	0
1-Jul-03	0.025	0.025	0	0.025	0.025	0	0.025	0.025	0
16-Jul-03	0.06	0.05	18	0.025	0.025	0	0.025	0.025	0
31-Jul-03	0.05	0.05	0	0.025	0.025	0	0.025	0.025	0