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CYPRUS PLATEAU MINING CORPORATION
A Cyprus Amax Company

Cyprus Plateau Mining Corporation
Post Office Drawer PMC
Price, Utah 84501
(801) 637-2875

May 15, 1996

RECEIVED
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DIVISION OF OIL
GAS & MINING PRICE UTAH

Ms. Pamela Grubaugh-Littig
Division of Oil, Gas and Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, UT 84180-1203

Re: 1995 Annual Report for Cyprus Plateau's Star Point Mines, ACT/007/006

Dear Ms. Grubaugh-Littig:

Enclosed please find the aforementioned. If you have any questions or need additional information, please do not hesitate to contact me.

Sincerely,

Johnny Pappas
Environmental Engineer

Enclosure

cc: J. Trackemas (w/o enclosures)

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COAL MINING AND RECLAMATION OPERATIONS FOR 1995

(Must be submitted to the Division by April 2, 1996)

State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining
3 Triad Center, Suite 350
355 West North Temple
Salt Lake City, Utah 84180-1203
(801) 538-5340

Permittee: CYPRUS PLATEAU MINING CORPORATION

Mine Name: STAR POINT MINES

Mailing Address: P.O. DRAWER PMC

Company Representative: JOHNNY PAPPAS

Resident Agent: C.T. CORPORATION SYSTEM

Permit Number: ACT/007/006

MSHA ID Number: 42-00171

Date of Initial Permanent Program Permit: JANUARY 27, 1982

Date of Permit Renewal: JANUARY 27, 1992

Quantity of Coal Mined (tonnage) 1995: 2,842,988

Attach Updated Mine Sequence Map(s) showing mine development through December 31, 1995.
(Same as Lease Royalty Payment Map and/or MSHA Progress Map)

All monitoring activities during the report period to be submitted with this report (including, but not limited to):

A. General

1. Discuss anomalies, missing data and monitoring changes made throughout the year.
2. Summarize any corrective actions and the results that may have occurred during the year.

B. Water Monitoring Data:
Groundwater Summary

1. Mine Discharge
   a. Summarize the total annual discharge from mine water discharge points and

CYPRUS PLATEAU MINING CORPORATION

STAR POINT MINES

1995 ANNUAL RECLAMATION

MONITORING REPORT

PREPARED FOR

CYPRUS PLATEAU MINING CORPORATION
P.O. DRAWER PMC
PRICE, UTAH 84501

PREPARED BY

IME
P.O. BOX 270
YAMPA, CO 80483

March 6, 1996

INTRODUCTION

This annual reclamation monitoring report is submitted by Cyprus-Plateau Mining Corporation, hereafter referred to as Plateau, in accordance with their approved Mining and Reclamation Plan, which requires that all previously reclaimed sites be monitored according to the monitoring schedule found on page 300 - 153 of the approved mining and reclamation plan, to determine the relative degree of revegetation success of these reclaimed areas. The Permit requires that the results and interpretation of these data be submitted to the Utah Division of Oil, Gas and Mining, hereafter referred to as the Division, each year in the form of an annual reclamation monitoring report. This report contains the results of data collected between August 16, 1995 and October 20, 1995 for the areas which required monitoring in 1995. These data were collected by Kent Crofts, Keith Olsen, Adam Olsen, Brenda Crofts and Katie Ann Crofts. The reclamation monitoring program conducted in 1995 is consistent with previously collected data and with Plateau's presently approved Permit.

Plateau has monitored the status of revegetation on reclaimed lands continuously since 1981, the results of which have been previously submitted on an annual basis to the Division. Due to the voluminous nature of these data, it is impracticable to provide a complete summary of the revegetation trends for each reclaimed site evaluated in the present report. Therefore, in order to completely understand the history and results of the prior reclamation monitoring, the reviewer is referred to these previous submittals.

SAMPLING METHODOLOGIES

The data collected in the 1995, utilized identical sampling methodologies and data analysis procedures used previously and which have been approved by the Division in earlier submittals. Parameters sampled in 1995 included total plant cover, woody plant densities and forage production. Given the similarity of previous sampling methodologies, Plateau believes that a comparison of the 1995 data with formerly collected data is

possible to establish trends regarding the successfulness of prior revegetation efforts.

Cover

Plant cover was monitored using two different sampling techniques. On the flatter more accessible areas associated with the Refuse Test Plots plant cover was evaluated using an inclined metal ten point frame. On the Refuse Test Plots, a fifty foot transect length was used and along each transect, the ten point frame was randomly located at intervals using random numbers, generated from a hand held calculator, which were assigned to the data sheets prior to going to the field. At each transect, ten sample sites equalling one hundred datum points were evaluated. All foliar plant cover less than one meter in height was sampled. At each sample point, the observation was recorded by individual plant species, or whether litter, rock, bare ground, lichens or cryptograms were encountered. Plant material that had dried prior sampling (such as annuals), but which was a product of the 1995 growing season, was counted as plant cover. Litter was defined as that plant material which had been dead for approximately one year prior to sampling. The one hundred datum points were summarized into a single observation which was used for subsequent statistical analyses. To the extent that the site configuration allowed, all transects were randomly located with respect to orientation and intervals between transects by assigning random numbers to the major compass headings while the interval between each transect was determined using a similar random number.

On steeper slopes, encountered at the Star Point Mine # 1 Area and along the Unit Train Loadout Conveyor, it was deemed unsafe because of the steep slopes to use the ten point frame. On these areas, plant cover was estimated using a 2 X 5 dm quadrat. Transect length was 14.52 feet. These transects were randomly located throughout the area to be sampled by randomly throwing the plot frame over the shoulder. Along each transect five plots were sampled. These five datums were then averaged into a transect value for statistical analyses.

Woody Plant Densities

On the Refuse Test Plots woody plant densities were determined using a 3 X 50 foot belt transect. The tape used for the cover transect was also used as the center point for the woody plant density transects. Each side of the transect tape was sampled for woody plants and these two values were averaged into a single observation for purposes of data summarization.

Woody plant densities were sampled only on the permanently reclaimed sites and no woody plant density sampling occurred on the interim reclaimed areas associated with the 1985 Reclamation Seedings.

Production

Total forage production was determined by clipping at ground level all biomass produced during the 1995 growing season within a one quarter square meter circular quadrat. On each production transect, five randomly spaced quadrats were clipped and these five plots were averaged into a single datum. Clipped plant materials were placed into labeled paper sacks and weighted in the field to determine green weights for initial sample adequacy determinations. Following completion of the field sampling, the production samples were returned to the laboratory where each sample bag was dried until free of moisture then weighted on an electric scale to an accuracy of one tenth of a gram.

Data Analysis

All of the field data were initially summarized in the field to determine plot values. Sample adequacy equations recommended by the Division were calculated on all data. Total plant cover and shrub density sample adequacy calculations were made in the field prior to leaving each sample plot. Final sample adequacy calculations were prepared in the laboratory following final completion of the data summary sheets. Sample adequacy calculations on production samples were initially based on green weights and were determined either in the field or at the completion of each sampling day. In accordance

with the previously approved sampling program for the Refuse Test Plots, a sufficient number of samples were taken to satisfy the 90/10 confidence interval requirement or until either a minimum of 7 samples or a maximum of 27 samples per plot had been collected. Statistical analyses of these data were performed using the NCSS statistical software package. Statistical tests performed included the two tailed t-test and ANOVA. Unless otherwise noted, the confidence interval for all statistical comparisons was the 0.10 percent level. Data collected from the Conveyor Edge Effect Sampling and from the one south facing plot were not included in the statistical analyses in order to ensure that uniformity of data was used with respect to slope and aspect.

Revegetation Success Criteria

Since no Reference Areas were formally sampled in connection with this sampling effort, comparisons regarding revegetation success on each individual reclaimed area with its appropriated Reference Area were made using data collected previously from these sites. Therefore, comparisons of the apparent degree of revegetation success on each reclaimed site were compared with the original permit data collected from these sites during either 1981 or 1983. A summary of the 1981-3 Reference Area Plant Cover values is presented below:

Reference Area	% Total Plant Cover
Mountain Shrub	45.3
Sagebrush	42.1
Douglas Fir	15.1
Mountain Grassland	43.6
Pinyon Juniper - West	12.8
Pinyon Juniper - East	32.5
Saltbush	17.5
Corner Canyon Aspen	87.6

RESULTS AND DISCUSSION

1985 Reclamation Seedings

A total of four sites reclaimed in 1985 were sampled in this monitoring effort. These sites corresponded to the Unit Train Loadout Conveyor Area, the Mine # 1 Seeding, the access road to the south of the Gentry Mountain Access Road which served the old Mine # 1 base area, and fourthly, a small access road located to the north of the Gentry Mountain Access Road which runs towards the coal processing plant area. Data was collected from each of these areas separately and is summarized in the following tables and narrative. The results obtained from these sampling efforts are presented in Tables 1 through 4.

Refuse Test Plots

The Refuse Test Plots were established by Plateau to address Division concerns regarding the reclamation potential of the coal refuse material generated during the coal benefication process. An extensive volume of information has been exchanged between Plateau and the Division relative to these test plots. Due to its volume, this material can not be repeated here. The best summary of these test plots can be found in the 1983, 1984, 1985, 1986, 1987, 1990 and 1991 Annual Reclamation Monitoring Reports previously submitted to the Division. In summary, these test plots were initially established to address the following objectives:

1. Evaluate the effectiveness of four plant growth mediums: topsoil, subsoil, topsoil over subsoil, and straight coal refuse;

2. Compare the effects of varying depth; 10 inches of topsoil, 20 inches of topsoil, 10 inches of subsoil, 20 inches of subsoil and 10 inches of topsoil over 10 inches of subsoil; and

3. Determine the effects of supplemental fertilization applied at rates of 100 and 200 pounds per acre to the combinations described in one and two above.

Based upon the results obtained from previous monitoring efforts, minor

modifications in the sampling regime have been periodically presented by Plateau and approved by the Division over the past several years. Specific agency recommendations relevant to the statistical comparisons and field sampling techniques are summarized in considerable detail in the 1986 and 1990 Annual Reclamation Monitoring Reports. The present evaluation uses identical analytical techniques used in all previously submitted reports. The only modification being that due to the very low composition of annuals, plant cover is analyzed using only total plant cover.

In sampling the Refuse Test Plots, sufficient area is often unavailable to sample to the required 90 percent confidence interval. Therefore on these plots a sufficient number of samples were collected until sample adequacy at the 90/10 confidence interval had been achieved or until a maximum of 27 samples per plot had been collected as approved by the Division in 1986. The 1995 monitoring effort was different than all previous sampling efforts in that the 90 percent confidence interval was used rather than the previously used 80 percent confidence interval. This change was made due to changes in the Division's regulations. However, on Plot C1, disturbed during the construction of the Unit Train Loadout Conveyor, insufficient area exists to sample to these levels. The number of samples collected from each plot and the appropriate sample adequacy are presented in Table 5, Refuse Test Plot Sample Adequacy Calculations.

Plant Growth Mediums. A comparison of various plant growth mediums described in item one of the study objectives for each corresponding plot is presented in Table 6, Mean Cover, Production and Density for Refuse Test Plots. A summary of the vegetal data by plant growth medium is presented in Table 7, Comparison of Refuse Test Plots Plant Growth Mediums.

These comparisons document that in 1995 the highest overall plant cover was associated with the straight topsoil plots, and there were no differences in plant cover when the topsoil and refuse plots were compared. Plant cover on the segregated topsoil

over subsoil as required by the Division's regulations and guidelines was significantly less than that associated with the straight topsoil and refuse plots but greater than that encountered on the straight subsoil plots. Significantly lowest cover was associated with the subsoil plots. Identical trends in plant cover were obtained from the 1990 and 1991 monitoring efforts, except that the refuse plots were not sampled in 1990.

Forage production in 1995 was determined to be highest on the straight topsoil plots and topsoil over subsoil plots yielded the second highest forage production values. The next lowest average production was associated with the subsoil plots which produced slightly more forage than did the refuse plots. In 1990 and 1991 highest forage production was also associated with the straight topsoil plots but the subsoil plots were found to have the lowest production values.

Shrub densities from the 1995 sampling were found to be significantly highest on the plots containing subsoil with the straight subsoil and topsoil over subsoil plots producing significantly higher shrub densities than either the topsoil or refuse plots. In 1990 there was no statistical difference in shrub densities between any of the three soil cover treatments while in 1991 highest shrub densities were associated with the same plots with identical rankings as found in 1995.

Data collected in 1995 verify the trends documented in the 1990 and 1991 sampling efforts. In 1995 significantly higher cover was also associated with the topsoil plots, with the topsoil over subsoil plots producing more plant cover than the straight subsoil plots. Identical trends existed for the 1990 and 1991 data collections. Straight refuse plots in 1995 and 1991 yielded the second highest cover values. Forage production in 1995 was greatest on the straight topsoil plots followed by the subsoil over topsoil plots and straight topsoil plots, just as were documented in 1991. Shrub densities in 1995 followed different patterns as those documented in 1990 and 1991. In 1995, highest shrub densities (18.30 plants per 150 ft2) were associated with the subsoil plots while in 1991 the highest shrub

densities (9.77 shrubs per 150 ft 2) were associated with the topsoil over subsoil plots. In 1990, the straight topsoil plots were found to produce the highest shrub densities (6.78 plants per 150 ft2).

When all four plant growth mediums are compared over time evidence suggests that shrub densities have increased most between the 1990-1991 and 1995 on the straight refuse plots 1991 value of 1.83 to a 1995 value of 8.57 shrubs per 150 square feet for a change of 368 %. The second greatest increase in shrub densities was for the subsoil plots which increased from an average in 1990 of 6.42 to a 1995 value of 18.30 shrubs per 150 square feet for a change of 185 %. The topsoil over subsoil plots increased in shrub densities in 1990 from 5.93 to a 1995 value of 15.00 for a change of 150 %. The lowest increase in shrub densities was for the topsoil plots which increased from a 1990 value of 6.78 to a 1995 value of 13.42 shrubs per 150 square feet for a change of only 98 %.

Thickness of Plant Growth Medium. All possible combinations of topsoil and subsoil depths were evaluated to determine whether the thickness or source of soil cover material affected plant growth. The results of this comparison suggest that plant growth is significantly affected by both the thickness and type of soil plant growth medium (Table 8, Refuse Test Plots Soil Depth Interactions).

Highest total plant cover values were associated with the 10 inch topsoil plots (Table 8, Refuse Test Plots Soil Depth Interactions) while lowest total plant cover values were consistently associated with the straight subsoil plots. Straight refuse produced total plant cover values significantly higher than that associated with the topsoil over subsoil and the subsoil plots. Identical trends were found for the 1990 and 1991 sampling efforts.

Forage production values were highest on the ten inch topsoil plots, followed by the twenty inch topsoil and ten inch topsoil over ten inch of subsoil plots. Lowest production was associated with the refuse plots with the twenty inch subsoil plots producing slightly

more forage. These were the identical trends reported in the 1990 and 1991 sampling efforts.

Shrub densities were found to be lowest on the straight refuse plots followed by the straight topsoil plots. Significantly higher shrub densities were found on the ten and twenty inch subsoil plots. Again, these are identical trends as reported in the 1990 and 1991 Annual Reclamation Monitoring Reports.

Comparing the 1995 data with that collected in 1990 and 1991 reveals almost identical trends over time. In all three sampling periods, highest plant cover was associated with the ten inch topsoil plots and lowest plant cover associated with the subsoil plots. Highest production in 1990 was associated with the twenty and ten inch topsoil plots while in 1995 almost identical patterns were found. Highest shrub densities in 1990 and 1995 were encountered on the ten inch subsoil plots. In both the 1990 and 1991 monitoring efforts, the ten inch topsoil over ten inch subsoil plots ranked second highest in shrub production while in 1995 they had moved to third place. The ranking of the lowest shrub density plots between 1990 and 1995 was also identical.

Fertilization. When averaged across all treatments, fertilization was not found to influence cover or production but significantly influenced shrub establishment (Table 9, Fertilizer Effect On Plant Growth Across all Refuse Test Plots). These results are consistent with the 1990 sampling effort which showed that fertilization significantly influenced shrub densities. However, in the 1991 sampling effort no differences in plant response could be documented. Differences appear to be a result of suppressed shrub establishment associated with the higher levels of fertilization, especially on the straight coal refuse, the ten inch subsoil and the twenty inch topsoil plots.

When averaged across all subsoil plots, fertilizer was not found to influence any measured plant parameter (Table 10, Fertilizer Effect on Plant Growth on Subsoil). Highest

plant cover, production and shrub densities were associated with the lower fertilizer rate but the differences were not statistically significant. Previous comparisons of the influence of fertilizer on subsoil from the 1987 through the 1991 monitoring efforts documented significant responses to all three measured plant variables.

On straight coal refuse materials, fertilization was not found to significantly influence plant cover or production fifteen years following application (Table 11, Fertilizer Effect on Plant Growth on Coal Refuse Plots). However, on these rather sterile soils, significantly higher shrub densities were associated with the lowest rate of fertilization fifteen years following application.

On the topsoiled plots no significant differences in plant response to fertilization were documented (Table 12, Fertilizer Effect on Plant Growth on Topsoil). Highest shrub densities were associated with the lowest rates of fertilization but these differences in 1995 were not significantly different.

For the topsoil over subsoil plots, fertilizer was not found to significantly influence plant cover (Table 13, Fertilizer Effect on Plant Growth on Topsoil Over Subsoil). Due to the very small area associated with Plot C1 it was not possible to collect production or shrub densities from this site so these comparisons could not be made.

On the ten inch subsoil plots, fertilizer was found to have a measurable influence only on shrub densities (Table 14, Fertilizer Effect on Plant Growth on Ten Inches of Subsoil). On the twenty inch subsoil plots, no differences in plant response could be found with different fertilizer rates (Table 15, Fertilizer Effect On Plant Growth on Twenty Inches of Subsoil).

On the ten inch topsoil plots, fertilizer was found to significantly influence only plant production (Table 16, Fertilizer Effect on Plant Growth on Ten Inches of Topsoil). For

some unexplained reason, plant production was significantly depressed at the higher fertilizer rates while shrub densities were slightly increased. In 1990 and 1991, significant differences in production and shrub densities were documented on these same plots between the two different levels of fertilization. Monitoring data collected from both years document that on ten inches of topsoil the higher rates of fertilizer inhibit forage production and stimulate shrub establishment.

On twenty inches of topsoil, fertilizer was found to influence forage production and shrub densities (Table 17, Fertilizer Effect On Plant Growth on Twenty Inches of Topsoil). The higher levels of fertilizer were associated with statistically higher forage production values but significantly lower shrub density levels. Similar trends existed in 1990 and 1991.

Conveyor Edge Effect. In order to address potential agency concerns that construction activities associated with the Unit Train Loadout Conveyor construction and associated disturbance of portions of some of the Refuse Test Plots might bias the data collected from the refuse test plots adjacent to the Conveyor cut, Plateau initiated a special sampling effort in 1985 to quantify whether the disturbance had altered the data collected from the undisturbed plots. Identical sampling methodologies have been used in 1985, 1986, 1987, 1990, 1991 and 1995 monitoring efforts. This comparison involves sampling the "edge effect" of plots located at varying distances from the crown of the conveyor cut. The "near" transects are located five feet away from the crown of the cut while the "away" transects are located twelve feet away.

The results of this comparison are presented in Table 18, Refuse Test Plots Conveyor Edge Effect. This comparison suggests that no measurable differences in plant growth exist between the "near" or "away" plots located near the conveyor cut for plant cover and production but that shrub establishment was lower on areas near the conveyor cut. Evaluation of the shrub density data over time clearly document that the conveyor cut has not resulted in a reduction in shrub densities on those sites nearest the cut. For

example in 1990 shrub densities of 5.00 and 6.38 plants per 150 square feet, respectively were reported for the "near" and "away" transects respectively. Values obtained from the 1995 sampling resulted in densities of 8.13 and 12.63 plants per 150 square feet, respectively for the "near" and "away" transects respectively. These values confirm that while shrub densities might be lower at those sites nearest the conveyor cut, when the density values from the 1990 sampling effort are compared with values obtained from the 1995 monitoring by means of the t-test statistical comparison the shrub densities values on the "near" transects have significantly increased. Plateau believes that these comparisons confirms the conclusions reached in the 1985, 1986, 1987, 1990 and 1991 Annual Reclamation Monitoring Reports, suggesting that the undisturbed portions of the remaining plots are yielding unbiased and scientifically acceptable data for the parameters of total plant cover and production.

Aspect Comparison. All but one of the Refuse Test Plots possess a northerly aspect. In all previous comparisons only plots having a similar aspect were compared. However, Plots D2 and G received identical treatments consisting of ten inches of subsoil with 100 pounds of fertilizer, the only difference being aspect. Plot D2 has a northerly aspect with Plot G faces to the south.

The results of this comparison are presented in Table 19, Refuse Test Plots Aspect Comparison. This comparison suggests that significantly higher cover is associated with the south facing slope while significantly higher shrub densities are found on the north facing slope. These trends are identical with those documented in the 1991, 1990, 1987 and 1986 monitoring efforts from these sites.

CONCLUSIONS

The reclaimed areas sampled at the Star Point Mines in 1995 monitoring effort included the 1985 Reclamation Seedings and the Refuse Test Plots. One site is interim reclamation while the other site is considered to represent permanent reclamation. Neither site was sampled with the object of obtaining final bond release, only to document reclamation trends and determine the apparent degree of revegetation success from these two sites.

The 1985 Reclamation Seedings are located on areas corresponding to several different plant communities with the Saltbush and Mountain Grassland Plant Communities being the most common prior to its disturbance. Portions of the Star Point Mine # 1 area correspond to the Douglas Fir Community. Using the previously collected data from the Mountain Grassland and Douglas Fir Reference Areas as a relative success standards for these sites, the average plant cover standard for this area, based upon 1981 for the Douglas Fir Reference Area and 1983 sampling for the Mountain Grassland Reference Area is 15.1 and 43.6 percent, respectively. The average plant cover for this site based upon the 1995 sampling is 20.56 percent. This suggests that for those portions of this reclaimed area which correspond to the Douglas Fir vegetation type, evidence suggests that the revegetation success standard with respect to plant cover has been satisfied.

The Refuse Test Plots correspond largely to the Sagebrush Vegetation Type and if final bond release were being sought, the success standard would largely be based upon the characteristics of the Sagebrush Reference Area. Table 20, Successfulness of Revegetation Efforts on Refuse Test Plots compares the apparent revegetation success standards from the Sagebrush Reference Area to each of the Refuse Test Plots. This comparison suggests that twelve of the thirteen plots satisfy the revegetation success standard with respect to plant cover. Upon comparing production, all of the thirteen Refuse Test Plots would satisfy the revegetation success standard with respect to production.

With respect to shrub density, twelve of the thirteen plots satisfy the shrub density standard of 600 shrubs per acre on south and west facing slopes and 2,200 shrubs on north and east facing slopes.

Several differences exist between the 1990 and 1991 findings regarding revegetation success and those obtained from the 1995 sampling. In 1990, five of the eleven plots sampled for cover, ten of eleven for production and eight of ten for shrub density satisfied the apparent criteria for bond release. For the 1991 sampling effort, three of the thirteen plots sampled for cover, ten of the thirteen plots sampled for production and six of the thirteen plots sampled for shrub density satisfied the apparent criteria for final bond release. These data clearly suggest that the reclaimed sites associated with the Refuse Test Plots have matured towards the required revegetation success standards.

It must be pointed out that these results obtained from 15 years of monitoring of the Refuse Test Plot are completely contrary with the apparent position of the Division regarding the requirements associated with the reclamation of coal refuse materials. For example, the Division informed Cyprus Plateau Mining Company in a letter dated October 4, 1995 in connection with the permitting actions associated with the Willow Creek Mine that "Recent reclamation efforts to direct seed and transplant into coal refuse have failed miserably and success has come only by covering the waste." Plateau can hardly consider the fact that revegetation attempts on the Star Point Mine Refuse Pile, when they appear to satisfy the current revegetation success standards of total plant cover, forage production and woody plant densities for bond release to have "failed miserably". Plateau respectfully submits that perhaps the Division has erroneously assumed that coal waste materials associated with the examples cited by the Division will ever exist at either the Star Point or Willow Creek Mine sites. Unfortunately, this understanding is completely unfounded in light of the significant improvements in the environmental performance standards, changes in mining technology and the coal benefication process which have occurred since the sites mentioned by the Division were affected. It appears that the

Division has mistaken assumed that the mining and coal refuse conditions associated with their AML sites exist today and thus the reclamation technologies used to reclaim coal refuse materials generated many decades earlier using completely different mining conditions also applies to refuse materials generated using more modern mining technologies. This assumption is completely incorrect as Plateau has previously documented to the Division for the Star Point Mine coal refuse pile that the characteristics of these refuse materials have changed significantly over time has the efficiency of the mining technologies and the coal benefication process have changed. Therefore, the conditions associated with coal refuse materials generated decades or years ago can never be duplicated using the current modern mining methods. The Division has apparently unknowingly compared apples with oranges by ever making the statement contained in this letter. Plateau believes that these data collected over a fifteen year monitoring period from a study initiated as a Division permit stipulation should receive adequate consideration in light of the conditions they document.

Table 1, 1985 Unit Train Loadout Conveyor Reclamation Seeding			
SPECIES	% COVER	% COMPOSITION	FREQUENCY
Grasses			
Desert Wheatgrass	2.54	11.74	75.0
Intermediate Wheatgrass	1.66	7.68	75.0
Smooth Bromegrass	1.03	4.77	25.0
Western Wheatgrass	0.70	3.23	29.2
Salina Wheatgrass	0.45	2.08	20.8
Indian Ricegrass	0.25	1.15	20.8
Great Basin Wildrye	0.14	0.65	8.3
Sandberg Bluegrass	0.02	0.08	4.2
Forbs			
Buckwheat	1.24	5.74	54.2
Chorispora	1.08	5.00	16.7
Yellow Sweetclover	0.65	3.00	41.7
Russian Thistle	0.56	2.58	33.3
Eaton Fleabane	0.40	1.85	12.5
Blue Aster	0.18	0.81	8.3
Cicer Milkvetch	0.07	0.31	4.2
Princes Plume	0.04	0.17	8.3
Alfalfa	0.03	0.15	8.3
Shrubs			
Rubber Rabbitbrush	6.22	28.71	87.5
Fourwing Saltbush	2.17	10.03	45.8
Cuneate Saltbush	1.58	7.31	33.3
TOTAL PLANT COVER	21.65	99.97	-
BARE	43.56	-	-
LITTER	16.78	-	-
ROCK	18.00	-	-
N = 24; MEAN = 21.65; SD = 7.04; Nm 90/10 = 28.6			

Table 2, 1985 Mine # 1 Reclamation Seeding			
SPECIES	% COVER	% COMPOSITION	FREQUENCY
Grasses			
Intermediate Wheatgrass	8.13	39.56	100
Great Basin Wildrye	1.68	8.17	60.0
Orchardgrass	1.60	7.78	73.3
Salina Wildrye	0.55	2.66	13.3
Desert Wheatgrass	0.15	0.71	20.0
Smooth Bromegrass	0.12	0.58	6.7
Indian Ricegrass	0.09	0.45	13.3
Sandberg Bluegrass	0.08	0.39	6.7
Kentucky Bluegrass	0.04	0.19	6.7
Forbs			
Blue Aster	3.33	16.21	93.3
Buckwheat	2.50	12.16	60.0
Eaton Fleabane	0.37	1.82	40.0
Astragalus	0.27	1.30	13.3
Curlycup Gumweed	0.20	0.97	40.0
Houndstongue	0.16	0.78	13.3
Yellow Sweetclover	0.04	0.19	6.7
Russian Thistle	0.06	0.19	6.7
Shrubs			
Basin Big Sagebrush	0.59	2.85	6.7
Western Snowberry	0.56	2.72	6.7
Broom Snakeweed	0.04	0.19	6.7
Douglas Fir	0.01	0.06	6.7
TOTAL PLANT COVER	20.56	99.93	-
BARE	30.01	-	-
LITTER	23.08	-	-
ROCK	26.35	-	-
N = 15; MEAN = 20.56; SD = 4.84; Nm 90/10 = 15.0			

Table 3, 1985 Mine # 1 South Access Road Reclamation Seeding			
SPECIES	% COVER	% COMPOSITION	FREQUENCY
Grasses			
Intermediate Wheatgrass	13.83	50.04	100
Orchardgrass	7.31	26.47	93.3
Salina Wildrye	1.03	3.74	40.0
Great Basin Wildrye	0.97	3.52	40.0
Kentucky Bluegrass	0.35	1.25	26.7
Smooth Bromegrass	0.28	1.01	13.3
Western Wheatgrass	0.25	0.92	20.0
Sheeps Fescue	0.10	0.36	13.3
Prairie Junegrass	0.04	0.14	6.7
Forbs			
Buckwheat	1.35	4.87	33.3
Yellow Sweetclover	0.47	1.71	26.7
Eaton Fleabane	0.24	0.87	20.0
Blue Aster	0.16	0.58	13.3
Curlycup Gumweed	0.15	0.53	20.0
Aster	0.04	0.14	6.7
Lewis Flax	0.03	0.10	6.7
Astragalus	0.03	0.10	6.7
Shrubs			
Rubber Rabbitbrush	0.65	2.36	20.0
Basin Big Sagebrush	0.33	1.21	26.7
TOTAL PLANT COVER	27.63	99.97	-
BARE	29.66	-	-
LITTER	26.01	-	-
ROCK	16.70	-	-
N = 15; MEAN = 27.63; SD = 6.64; Nm 90/10 = 15.6			

Table 4,
1985 North Access Road Reclamation Seeding

SPECIES	% COVER	% COMPOSITION	FREQUENCY
Grasses			
Intermediate Wheatgrass	7.53	37.87	100
Orchardgrass	4.34	21.84	93.3
Salina Wildrye	2.49	12.55	66.7
Kentucky Bluegrass	0.07	0.36	13.3
Sandberg Bluegrass	0.05	0.24	6.7
Great Basin Wildrye	0.05	0.24	13.3
Desert Wheatgrass	0.05	0.24	6.7
Smooth Bromegrass	0.04	0.18	6.7
Western Wheatgrass	0.04	0.18	6.7
Forbs			
Yellow Sweetclover	3.40	17.10	93.3
Eaton Fleabane	0.33	1.66	40.0
Prickly Lettuce	0.18	0.89	13.3
Houndstongue	0.13	0.65	13.3
Cicer Milkvetch	0.12	0.59	20.0
Western Yarrow	0.09	0.47	13.3
Buckwheat	0.06	0.35	6.7
Blue Aster	0.06	0.35	13.3
Common Dandelion	0.04	0.18	6.7
Astragalus	0.04	0.18	6.7
Curlycup Gumweed	0.04	0.18	6.7
Shrubs			
Western Snowberry	0.29	1.48	13.3
Broom Snakeweed	0.28	1.42	20.0
Douglas Rabbitbrush	0.13	0.65	6.7
Utah Serviceberry	0.06	0.35	13.3
TOTAL PLANT COVER	19.88	100.2	-
BARE	36.34	-	-
LITTER	22.34	-	-
ROCK	21.44	-	-
N = 17; MEAN = 19.88; SD = 5.19; Nm 90/10 = 18.4			

Table 5,
Refuse Test Plots Sample Adequacy Calculations.

PLOT	PARAMETER	# SAMPLES	ADEQUACY Nm90/10
A1 Refuse - 100 #	cover production density	27 27 27	35.9 170.5 54.9
A2 Refuse - 200 #	cover production density	27 27 27	36.9 91.8 176.8
B1 20" Subsoil - 200 #	cover production density	8 27 28	6.9 18.3 52.3
B2 (Disturbed) 20" Subsoil - 100 #	cover production density	7 24 27	4.7 23.9 6.4
C1 (Disturbed) 10" TS/10" SS - 100 #	cover production density	12 - -	18.8 - -
C2 10" TS/10" SS - 200 #	cover production density	7 19 27	6.1 14.1 20.9
D1 10" Subsoil - 200 #	cover production density	7 27 28	1.6 18.2 15.4
D2 10" Subsoil - 100 #	cover production density	7 27 22	6.6 26.8 13.5
E1 20" Topsoil - 100 #	cover production density	10 27 22	6.7 19.0 16.5
E2 20" Topsoil - 200 #	cover production density	11 29 27	9.8 29.8 23.4
F1 10" Topsoil - 200 #	cover production density	7 27 27	4.1 43.5 32.8
F2 10" Topsoil - 100 #	cover production density	7 27 27	5.5 52.0 66.6
G 10" Subsoil - 100 # South Aspect	cover production density	11 27 27	6.1 81.8 112.9

Table 6,
Mean Comparison of Cover, Production and Density of Refuse Test Plots.

PLOT	PERCENT COVER	PRODUCTION (grams per 1/4 m2)	DENSITY (# shrubs per 150 ft2)
A1	28.48	9.18	12.06
A2	27.44	9.77	5.09
B1	17.88	12.15	18.89
B2	18.14	12.81	16.91
C1	21.25	-	-
C2	24.00	19.00	15.00
D1	19.57	18.66	17.11
D2	21.57	18.85	20.70
E1	25.20	22.81	15.61
E2	25.91	26.45	11.59
F1	37.14	22.31	14.11
F2	41.86	27.11	12.07
G	26.09	18.23	13.63

Table 7,
Comparison of Refuse Test Plot Plant Growth Mediums.

MEDIUM	PERCENT COVER	PRODUCTION (grams per 1/4 m2)	DENSITY (# shrubs per 150 ft2)
Refuse	27.96c*	9.47a	8.57a
Subsoil	19.24a	15.70b	18.30c
Topsoil/Subsoil	22.26b	19.00c	15.00b
Topsoil	31.14c	24.70d	13.24b

* means within a column followed by a different letter are significantly different at the 0.05 level.

Table 8,
Refuse Test Plots Soil Depth Interactions.

MEDIUM / DEPTH	PERCENT COVER	PRODUCTION (grams per 1/4M2)	DENSITY (# shrubs/150 ft2)
Refuse	27.96c*	9.47a	8.57a
10" Subsoil	20.57b	18.75c	18.72d
20" Subsoil	18.00a	12.46b	17.92cd
10" Topsoil	39.50d	24.71d	13.09b
10" Topsoil/10" Subsoil	22.26b	19.00c	15.00bc
20" Topsoil	25.57c	24.70d	13.40b

* Means within a column followed by a different letter are significantly different at the 0.05 level.

Table 9,
Fertilizer Effect on Plant Growth Across all Refuse Test Plots.

PARAMETER	MEAN	STANDARD DEVIATION	N	t-cal	LEVEL OF SIGNIFICANCE
Total Plant Cover (%)					
100 # / Acre	26.08	5.39	70		
				0.8859	NS
200 # / Acre	25.32	4.60	67		
Production (grams per 1/4m2)					
100 # / Acre	18.15	6.99	132		
				0.1179	NS
200 # / Acre	18.06	5.96	156		
Shrub Density (# shrubs / 150 ft2)					
100 # / Acre	15.47	4.50	125		
				3.1486	0.01
200 # / Acre	13.63	5.22	164		

Table 10,
Fertilizer Effect on Plant Growth on Subsoil.

PARAMETER	MEAN	STANDARD DEVIATION	N	t-cal	LEVEL OF SIGNIFICANCE
Total Plant Cover (%)					
100 # / Acre	19.86	3.22	14		
				1.1136	NS
200 # / Acre	18.73	2.18	15		
Production (grams per 1/4m2)					
100 # / Acre	15.83	4.87	51		
				0.4841	NS
200 # / Acre	15.41	4.00	54		
Shrub Density (# shrubs / 150 ft2)					
100 # / Acre	18.81	3.61	49		
				0.6991	NS
200 # / Acre	18.00	7.37	56		

Table 11,
Fertilizer Effect on Plant Growth on Coal Refuse Plots.

PARAMETER	MEAN	STANDARD DEVIATION	N	t-cal	LEVEL OF SIGNIFICANCE
Total Plant Cover (%)					
100 # / Acre	28.48	10.38	27		
				0.3728	NS
200 # / Acre	27.44	10.12	27		
Production (grams per 1/4m2)					
100 # / Acre	9.18	7.29	27		
				0.3315	NS
200 # / Acre	9.77	5.69	27		
Shrub Density (# shrubs / 150 ft2)					
100 # / Acre	12.06	5.43	27		
				5.3135	0.001
200 # / Acre	5.09	4.12	27		

Table 12,
Fertilizer Effect on Plant Growth on Topsoil.

PARAMETER	MEAN	STANDARD DEVIATION	N	t-cal	LEVEL OF SIGNIFICANCE
Total Plant Cover (%)					
100 # / Acre	33.53	4.98	17		
				1.2136	NS
200 # / Acre	31.53	4.77	18		
Production (grams per 1/4m2)					
100 # / Acre	24.96	8.97	54		
				0.3411	NS
200 # / Acre	24.38	8.86	56		
Shrub Density (# shrubs / 150 ft2)					
100 # / Acre	13.84	4.93	49		
				1.1047	NS
200 # / Acre	12.85	4.16	54		

Table 13,
Fertilizer Effect on Plant Growth on Topsoil Over Subsoil.

PARAMETER	MEAN	STANDARD DEVIATION	N	t-cal	LEVEL OF SIGNIFICANCE
Total Plant Cover (%)					
100 # / Acre	21.25	5.59	12		
				1.1607	NS
200 # / Acre	24.00	3.61	7		
Production (grams per 1/4m2)					
100 # / Acre	-	-	-		
				-	-
200 # / Acre	19.00	4.34	19		
Shrub Density (# shrubs / 150 ft2)					
100 # / Acre	-	-	-		
				-	-
200 # / Acre	15.00	4.17	27		

Table 14, Fertilizer Effect on Plant Growth on Ten Inches of Subsoil.					
PARAMETER	MEAN	STANDARD DEVIATION	N	t-cal	LEVEL OF SIGNIFICANCE
Total Plant Cover (%)					
100 # / Acre (D2)	21.57	3.36	7		
				1.4365	NS
200 # / Acre (D1)	19.57	1.51	7		
Production (grams per 1/4m2)					
100 # / Acre (D2)	18.85	5.93	27		
				0.1291	NS
200 # / Acre (D1)	18.66	4.83	27		
Shrub Density (# shrubs / 150 ft2)					
100 # / Acre (D2)	20.70	4.63	22		
				2.9106	0.01
200 # / Acre (D1)	17.11	4.08	28		

Table 15, Fertilizer Effect on Plant Growth on Twenty Inches of Subsoil.					
PARAMETER	MEAN	STANDARD DEVIATION	N	t-cal	LEVEL OF SIGNIFICANCE
Total Plant Cover (%)					
100 # / Acre (B2)	18.14	3.08	7		
				0.1698	NS
200 # / Acre (B1)	17.88	2.85	8		
Production (grams per 1/4m2)					
100 # / Acre (B2)	12.81	3.80	24		
				0.6770	NS
200 # / Acre (B1)	12.15	3.16	27		
Shrub Density (# shrubs / 150 ft2)					
100 # / Acre (B2)	16.91	2.59	27		
				0.9393	NS
200 # / Acre (B1)	18.89	10.65	28		

Table 16,
Fertilizer Effect on Plant Growth on Ten Inches of Topsoil.

PARAMETER	MEAN	STANDARD DEVIATION	N	t-cal	LEVEL OF SIGNIFICANCE
Total Plant Cover (%)					
100 # / Acre (F2)	41.86	5.98	7		
				1.6552	NS
200 # / Acre (F1)	37.14	4.60	7		
Production (grams per 1/4m2)					
100 # / Acre (F2)	27.11	11.89	27		
				1.6766	0.10
200 # / Acre (F1)	22.31	8.94	27		
Shrub Density (# shrubs / 150 ft2)					
100 # / Acre (F2)	12.07	5.99	27		
				1.3687	NS
200 # / Acre (F1)	14.11	4.91	27		

Table 17,
Fertilizer Effect on Plant Growth on Twenty Inches of Topsoil.

PARAMETER	MEAN	STANDARD DEVIATION	N	t-cal	LEVEL OF SIGNIFICANCE
Total Plant Cover (%)					
100 # / Acre (E1)	25.20	3.97	10		
				0.3610	NS
200 # / Acre (E2)	25.91	4.93	11		
Production (grams per 1/4m2)					
100 # / Acre (E1)	22.81	6.05	27		
				1.7949	0.10
200 # / Acre (E2)	26.45	8.77	29		
Shrub Density (# shrubs / 150 ft2)					
100 # / Acre (E1)	15.61	3.86	22		
				3.8686	0.001
200 # / Acre (E2)	11.59	3.41	27		

Table 18,
Refuse Test Plots Conveyor Edge Effect.

PARAMETER	MEAN	STANDARD DEVIATION	N	t-cal	LEVEL OF SIGNIFICANCE
Total Plant Cover (%)					
Near	21.13	8.11	8		
				0.2484	NS
Away	22.13	7.99	8		
Production (grams per 1/4m2)					
Near	18.67	7.58	8		
				0.5294	NS
Away	16.69	7.38	8		
Shrub Density (# shrubs / 150 ft2)					
Near	8.13	3.56	8		
				1.8540	0.10
Away	12.63	5.87	8		

Table 19,
Refuse Test Plots Aspect Comparison.

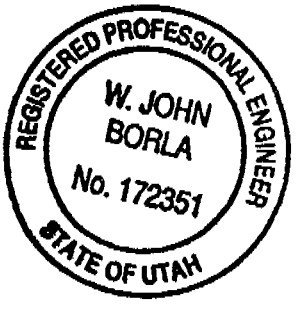
PARAMETER	MEAN	STANDARD DEVIATION	N	t-cal	LEVEL OF SIGNIFICANCE
Total Plant Cover (%)					
North (D2)	21.57	3.36	7		
				2.0880	0.10
South (G)	26.09	5.03	11		
Production (grams per 1/4m2)					
North (D2)	18.85	5.93	27		
				0.2765	NS
South (G)	18.23	10.03	27		
Shrub Density (# shrubs / 150 ft2)					
North (D2)	20.70	4.63	22		
				3.4000	0.01
South (G)	13.63	8.80	27		

Table 20, Successfulness of Revegetation Efforts on Refuse Test Plots			
PLOT	PERCENT TOTAL COVER	PRODUCTION (grams per 1/4m2)	SHRUB DENSITY (# shrubs/acre)
SUCCESS STANDARD	22.00	11.04	900 or 2200
A1	28.48 yes	9.18 yes	3,502 yes
A2	27.44 yes	9.77 yes	1,478 no
B1	17.88 no	12.15 yes	5,486 yes
B2	18.14 yes	12.81 yes	4,911 yes
C1	21.25 yes	- yes ??	- yes ?
C2	24.00 yes	19.00 yes	4,356 yes
D1	19.57 yes	18.66 yes	4,969 yes
D2	21.57 yes	18.85 yes	6,011 yes
E1	25.20 yes	22.81 yes	4,533 yes
E2	25.91 yes	26.45 yes	3,366 yes
F1	37.14 yes	22.31 yes	4,098 yes
F2	41.86 yes	27.11 yes	3,505 yes
G	26.09 yes	18.23 yes	3,958 yes

Cyprus Plateau Mining Corporation
1995 Sediment Pond Certification
(R645-301-514.311)

I hereby certify that I am a registered professional engineer in the State of Utah. I certify that I have made or have had made by a qualified inspector an inspection of Sediment Ponds 1 through 9 and three water impoundments at Cyprus Plateau Mining Corporation's Star Point Mine. All of the pond embankments appear to be stable and in good physical condition. There are no apparent structural weaknesses or other hazardous conditions. I certify that I have reviewed the documentation pertaining to Attachment A and that to the best of my knowledge the information shown thereon is accurate.

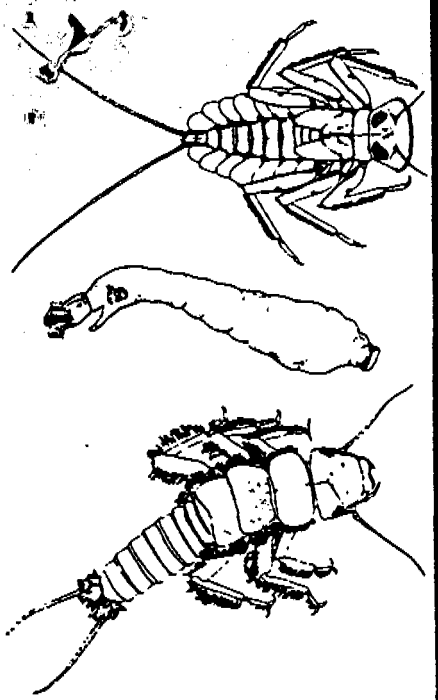
W. John Borla Date: 12-20-95
John Borla

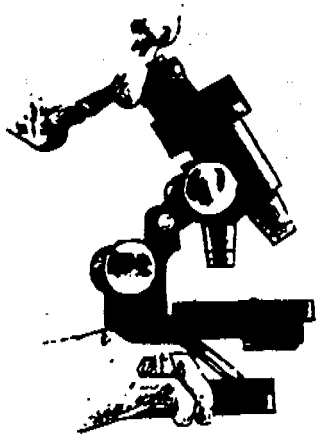


ATTACHMENT A
SEDIMENT PONDS STORAGE CAPACITIES

Pond	Date	Decant Elevation	Depth of Water in Feet From Decant Level	Elevation of Water	Sediment Storage Capacity in A.F.	Sediment Storage Volume Used in %	Sediment Storage Volume Remaining in A.F.
1	12/14/95	8302.10	0.5	8301.6	0.36	56	0.16
2	12/14/95	7718.75	2.5	7716.25	1.92	8	1.76
3	12/14/95	8100.85	4.5	8096.35	1.77	28	1.27
4	12/14/95	7313.00	1.0	7312.00	0.44	50	0.22
5	12/14/95	7393.00	Dry	Dry	2.42	31	1.67
6	12/14/95	7142.70	Dry	Dry	0.76	40	0.46
7	12/14/95	7206.00	Dry	Dry	0.04	0	0.04
8	12/14/95	7049.90	Dry	Dry	1.10	60*	0.44
9	12/14/95	7439.30	2.0	7437.30	2.02	10	1.82
Wash Plant East	12/19/95	7480.00	Dry	Dry	N/A	N/A	N/A
Wash Plant West	12/19/95	7483.00	0	7483.0	N/A	N/A	N/A
Wash Plant Clear Water	12/19/95	7468.50	3.0	7465.50	N/A	N/A	N/A

*Pond 8 is being cleaned as of 12/12/95





AQUATIC ECOSYSTEM INVENTORY

Macroinvertebrate Analysis

MANTI-LASAL NATIONAL FOREST

FERRON AND PRICE RANGER DISTRICTS

1995

NATIONAL AQUATIC ECOSYSTEM MONITORING CENTER

18 Mar 96

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Macroinvertebrate Analysis

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INTRODUCTION

The goal of the Clean Water Act is to preserve and restore the biological integrity of aquatic resources. Monitoring is a tool we use to measure our management successes and failures. Under the Clean Water Act federal agencies have the responsibility for monitoring water quality and associated habitat quality on federally managed lands.

Aquatic macroinvertebrates are an important component of aquatic ecosystems and have long been used to evaluate water and habitat quality. After considering all of the biotic components of an aquatic ecosystem macroinvertebrates are one of the best suited for monitoring and can provide valuable information to assist in making resource decisions. They are relatively easy to collect and identify, are not as mobile as fish, they have sufficiently long life cycles to integrate environmental changes over an annual period, and they provide a vital link in the food chain between primary producers (algae and macrophytes) and fish. They have also been shown to be a cost effective monitoring tool for evaluating the effects of management activities on stream and riparian condition.

This report provides an assessment of the aquatic ecosystems based on the aquatic macroinvertebrate communities. The information provided should be integrated with other data collected in the watershed to gain a more complete understanding of conditions, possible impacts, and trends.

The data for this evaluation are from 42 aquatic macroinvertebrate samples from 8 stations on 8 streams along with water chemistry and physical habitat data provided by your aquatic specialist(s).

SAMPLING METHODS

Samples were taken stratified randomly from the riffle habitat with a Winget-Modified Surber Net, which provides one square foot samples. The 280 micron mesh net collects even the smallest insect instars. These are quantitative, reproducible samples, and the data obtained can be used in ecosystem management to document conditions and trends in relation to management activities in drainages. They provide a basis for spatial and temporal monitoring.

LABORATORY PROCESSING

The aquatic macroinvertebrates were identified in the USFS National Aquatic Ecosystem Monitoring Centers' BYU-Provo, UT Laboratory.

1--Subsampler

Samples were subsampled by placing them in a 1000 ml beaker which is positioned over an automated subsampler containing eight pans with fine-meshed screens on the bottom. The pans are rotated on a phonograph-like table and the sample is flushed from the beaker with water delivered through a tube to the bottom of the beaker. The subsampler has been shown to divide the sample into eight equal parts with high efficiency. Large taxa (such as stoneflies) are added to the subsample to be processed. The contents of one to eight pans are processed and standardly 250-300 organisms are picked from the sample.

2--DAT Diversity Index

Data for the DAT Diversity Index--can be obtained while picking the macros from the petri dishes. An accurate DAT is dependent upon taxonomic training of technicians. Technicians should be trained to identify the taxa as they pick them from the sample. Many of the taxa should be identified to the genus or species level. A Veeder Root counter can be used to count taxa picked and to record the diversity.

3--Taxonomy

The macroinvertebrates are classified to species when keys to nymphs/larvae are available (mostly mayflies) to genus for most other orders of insects.

Chironomids are not classified past tribe, some other diptera are taken to family, and miscellaneous invertebrate taxa are sometimes taken to class, order or even phylum. There are so many good indicators of conditions in the EPT orders and dipterans that there has been a great deal of positive feedback about the accuracy of evaluations of ecosystems and thus we feel quite comfortable with these levels of taxonomic identification.

4--Microscopes

Samples are picked with the aid of a dissection-type microscope, and a zoom-magnification feature is desirable. The taxa are separated into small, 35 X 10 mm petri dishes with micro-fine pointed forceps.

A Nikon 0.8 to 4 X lens and 10X eyepiece provides ample magnification for basic Taxonomy. A Leica Stereozoom 0.7 to 3X lens and 10X or 20X eyepiece provides excellent optics for most structures used for identification.

A compound microscope to 90X is helpful for finer detail needed for some invertebrate identifications.

5--Dry Weight Biomass

Following identification and enumerations samples are oven dried in small aluminum 5/8ths inch deep X 2.25 inch pans at 75 degrees Celsius for 8 hours to get dry-weight biomass, which is reported as a mean in grams/m^2/station/date. These data are valuable to help assess fishery potential and benthic community productivity and health.

6--Quality Control

For quality control in the Provo-BYU lab, every sample is checked and the data recorded by our full-time Quality Control Taxonomist who has worked in the lab for over eleven years. Occasionally final resolution is reached through our joint effort. Our lab was 'certified' by EPA in the early 1980's. Loys Parrish visited the lab and consequently sent a letter of approval.

DATA ANALYSIS

The evaluation of ecosystem integrity and health is based upon aquatic macroinvertebrate data and information along with physical habitat and water quality information provided by your aquatic specialist.

Although the BCI has been the most reliable index used over the years, other indices are being tested and may provide some insight about community structure and health. Numerical values for some of these indices, a discussion of their proposed use and observed weaknesses is included in this report.

Tolerances of individual taxa is indicated by alphabetic and other symbols for each taxon on computer printouts.

INDICES Biotic Condition Index (BCI)

This index has been developed by the USDA Forest Service over the past 18 years, providing a versatile monitoring tool for evaluating conditions in aquatic ecosystems and associated drainages.

This index -

1. measures a stream against its own potential, not that of another stream.

2. is sensitive to most forms of environmental stress.
3. is applicable to various types and sizes of streams.
4. provides a basis for assessment of unstressed to stressed conditions.
5. is independent of sample size, if sample contains a representative assemblage of the species in the community.
6. is based upon data easily acquired.
7. (meshes with and supports stream habitat and water quality data). Integrates biological, physical habitat and water chemistry data.
8. is easily understood, like a score on a test.
9. is particularly useful for monitoring trends.
10. is based mainly upon tolerances (TQ's) of benthic invertebrate taxa (in the sampled community), (84)(88).

Tolerance quotient values used for the BCI have been refined/validated through research on the environment profiles of selected mayfly species (89)(90)(91) using the vast Forest Service database.

Weaknesses:

If a species is present in low numbers, it is treated as if it were present in resident population numbers. The use of CTQd compensates for this in some cases, but it may require further interpretation.

Taxa (species) richness

This index is based upon the fact that a community with good taxonomic diversity generally indicates better conditions than one with low taxonomic diversity (50). This can be a useful metric under certain good conditions.

A good number of families, genera, or species depends upon:

-- the level of taxonomic classification,
-- elevation,
-- topography and parent soil types which affect the water chemistry in the drainage.

Weaknesses:

1. A community may have excellent diversity in an ecosystem with a long history of environmental impacts, and all of the taxa will be those with high tolerance levels.
   - EPT (mayfly, stonefly and caddisfly) species may be present, but would be tolerant species.
2. Organic enrichment can increase biodiversity.
3. This index depends upon sample size (Yapp, 1979).

EPT/Chironomidae

Theoretically, this index compares groups of aquatic insects that have the most clean water (sensitive) species with Chironomidae, a family with a majority of the species tolerant to many forms of pollution (82).

Weaknesses:

1. All or most of the EPT species could be tolerant to the perturbations being evaluated. Thus, one would be comparing tolerant to tolerant species which would not provide the intended contrast. A low

value will often provide a false impression about the environmental quality of an ecosystem.
2. The Chironomid species present could be moderately tolerant to sensitive species.

EPT Index

This index is based upon the fact that most of the cleanwater species are found in the Orders Ephemeroptera, Plecoptera, and Trichoptera. In some cases this will be a valid index.

Percent of the community needed to be in these groups to indicate fair or good or excellent conditions depends upon level of classification.

Weaknesses:

1. Some or all of the EPT species might be tolerant to moderate or severe perturbations.

Percent of Shredder Functional Feeding Group and Total Number of Individuals

Shredders are good indicators of riparian Zone Impacts and may show effects of toxicants adsorbed to the leaves that can affect the microbiological communities that colonize the Coarse Particle Organic Matter (CPOM), (leaves), or can affect shredders directly (82).

Weaknesses:

1. Some shredders are facultative - can utilize in-stream periphyton rather than leaves. Indicators of riparian health must be carefully chosen.
2. Depending upon species present this may or may not be a valid index.

Modified Hilsenhoff Biotic Index (HBI)

Used for EPA RBP-III, this organic enrichment index is based broadly upon family taxonomy. The scale 1-10 is used to estimate the chances that a taxon from a given family would be tolerant to organic enrichment.

This index would work best where an ecosystem has severe organic enrichment impacts. A stream with low organic nutrients would have a low score. Ecosystems with extreme organic enrichment impacts would have a high score (up to 10).

Taxa are assigned TV's (Tolerance Values). The mean value for the community indicates the pollution level. Water with values 0-2 are considered clean, 2-4 slightly enriched, 4-7 enriched and 7-10 polluted (43,44,45).

Weaknesses:

1. Each family of aquatic macroinvertebrates has species which do not compete well where there is organic enrichment. Alignment with tolerances of species in the community could be "right on," completely wrong, or somewhere in between.
2. This index is not designed to detect non-organic effects.

DIVERSITY INDICES

(Variations of Shannon Weaver, 1949)
Shannon's 1949

These indices are based upon the information theory, the more species there are in the community, the more "information." It is a measure of the average degree of "uncertainty" in predicting to what species an individual chosen at random will belong. This increases as the number of species increases and distribution of individuals among species becomes even (83).

Scale:
- 0 - 1 Poor diversity
- 1 - 2 Fair diversity
- 2 - 3 Good diversity
- >3 Very good diversity

Weaknesses:

1. If a severely stressed community had a low number of species and each species had close to the same number of organisms, this index would indicate perfect conditions.
2. Diversity, richness and evenness indices often provide a false high. Elimination of a few clean-water species could 'even' the community and show better conditions instead of warning of increased impacts.
3. A dominance among sensitive species could show stress conditions.

Simpson's Index 1949

Values from 0 to 1. Gives probability of two individuals drawn at random from population belonging to the same species. If the probability is high, then the community diversity is low. The higher the number, the higher the diversity (46).

Shannon - Weaver D.I.

Dbar - Dominance Index - values range from 0 - 4.

0 - 1	Poor
1 - 2	Fair
2 - 3	Good
3 - 4	Excellent

RICHNESS INDICES

Menhinick Index (1967) - Margalefs Index (1958)

M.I. = Index of species richness = $\frac{s}{\sqrt{n}}$

(s = number of species in community)
(n = number of organisms)

$s=k\sqrt{n}$ This index presupposes that a functional relationship exists between s and n, or where k is the constant. This must hold true or M.I. will vary with samples containing different values of n. Therefore, communities cannot be compared (83).

s = 30, n = 100, M.I. = 3
s = 15, n = 25, M.I. = 3
s = 10, n = 25, M.I. = 2

Weaknesses:

1. These richness indices vary with sample size.
2. Communities cannot be compared.
3. Must use samples of equal size to work.
4. It is possible to use a rarefaction curve for each habitat sampled to correct for different sample sizes. This is based upon a model dealing with the probabilities that each species will be included in the sample.

Evenness Index

Evenness is a measure of the distribution (numbers of organisms) for taxa in the community. When all species in a community are equally abundant, the index is maximum. It decreases toward zero as abundances of species diverge away from evenness (87).

Percent Contribution of Dominant Taxon

A community dominated by a relatively few species would indicate environmental stress (82). This metric is based upon taxonomic identifications to genus or species level. Values range from 1 to 100%. Lower values indicate a more balanced community and better water quality

Community Similarity Indices

These are used when reference communities exist.

1. Community Loss Index - measures the loss of species between reference and experimental stations. Values = 0 to infinity (83).

$$\text{I (community loss)} = \frac{a-c}{b}$$

(a = # taxa at unimpacted site)
(b = # taxa at study site)
(c = # taxa common to a and b)

2. Jaccard Coefficient of Community - indicates similarity in taxonomic composition. Coefficient increases from 0 to 1.0 as similarity increases between communities (83). This index will show stronger relationships between species with similar tolerances.

3. Index of Similarity Between Two Samples - to detect shifts in community assemblages sites above and below pollution impact (83).

a = # species in Sample 1
b = # species in Sample 2
c = # species common to both samples

$$s = \frac{2c}{a+b}$$

Ratio of Scraper and Filtering Collector Functional Feeding Groups

Theory: Imbalances in community would indicate stress conditions in the ecosystem (83). This is often true but requires interpretation.

A description of the functional feeding group concept is recorded in Cummins (1973). Genus-level functional feeding groups can be found in Merrit & Cummins (1984).

Feeding groups may be specialists for a specific food resource or facultative and thus able to use a broader range of food resources.

The trophic generalists are expected to be better able to tolerate disturbance to aquatic habitats and may become numerically dominant because they are more flexible in foods utilized.

- -- The numbers of scrapers is highest where there is an abundance of diatoms, lower where filamentous algae or mosses are the dominant vegetation.
- -- Organic enrichment increases the numbers of filtering collectors by increasing the phytoplankton and zooplankton they feed upon.
- -- Sedimentation could add another dimension to this formula by covering rocks and diatoms used by scrapers.
- --In general 50 to 75% scrapers is considered favorable.

Weaknesses:

1. Toxicants in the water chemistry could be absorbed by any of the forms of phytoplankton or periphyton and could affect this ratio.
2. Numbers of filtering collectors may vary seasonally.
3. Some scrapers are more tolerant than others, but in general represent more sensitive species.

DUCK FORK

Station 1, 75 yd above reservoir - August 15, 1995

Cleanwater taxa indicated good water quality and good instream substrate and included *Epeorus, Rhithrogena, Drunella doddsi, Zapada cinctipes, Zapada oregonensis,* Leuctridae, *Arctopsyche grandis,* and *Parapsyche elsis.*

The observed number of shredders in the community is generally found where the riparian habitat is in excellent condition. With a stream gradient of 1.5, this stream reach should have good maintenance capability. The DAT at this station was 18.6, which indicates excellent biodiversity. There was a good balance among the benthic invertebrate trophic groups, which indicated good stability in this ecosystem.

There appeared to be good potential for a fishery at this station. The macroinvertebrate biomass of 2.1 g/m^2 could provide nutrients for a good fishery. The clean water taxa present indicated that there should be some suitable spawning substrate.

The BCI of 98 indicated that this stream reach was close to meeting its potential. A management option might be to maintain existing good conditions in this aquatic ecosystem. The benthic invertebrate community in this ecosystem will provide an excellent tool to monitor possible effects from planned timber harvest activities in this drainage.

MACROINVERTEBRATE ANALYSIS

Investigator: JILL DUFOUR
Forest/District: MANTI-LASAL NF/FERRON DISTRICT
Stream: DUCK FORK
State/County: UTAH/EMERY COUNTY

Station	Location	Date	Diversity Index DAT (mean)	Standing Crop g/m^2 (mean)	Number of Organisms /m^2	Number of Taxa	Biotic Condition Index BCI 50
1		8 15 95	18.6	2.1	4,887	29	98

Scale	DAT	Standing Crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1 Duck Fork, 75 yd above reservoir, Emery County, Manti-Lasal NF, Ferron District DATE: 8 15 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	29	4887	1759	8015	2872.49	33.94	58.78	3.6671	52	51

EPT Index is 67.18%.
EPT/Chironmidae is 3.49.
The Margalef Index of richness is 3.296.
The Menhinick Index of richness is 0.415.
Simpson's Diversity Index is 0.115.
Hill's Evenness Index is 0.686.
Shannon's Index is 2.542.
The Modified Hilsenhoff Tolerance Index is 3.000.
Percent contribution of dominant taxa is 70.78%.
Ratio of Scrapers to Collector-Gatherers is 0.583596.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.164464.
Ratio of Coll/Gath functional feeding group to total number of organisms is 0.698238.
Ratio of Filterer functional feeding group to total number of organisms is 0.060940.
Ratio of Scraper functional feeding group to total number of organisms is 0.407489.
Ratio of Predator functional feeding group to total number of organisms is 0.077827.
Ratio of Piercer functional feeding group to total number of organisms is 0.090308.

- = Clean Water Taxa
⊥ = Moderately Tolerant Taxa
□ = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
Ū = Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Duck Fork, 75 yd above reservoir, Emery County, Manti-Lasal NF, Ferron District DATE: 8 15 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE	MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		-	126	2.099	18	37
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		⊥	689	2.838	30	85
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		-	129	2.111	21	44
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	HEPTAGENIA		⊥ O	75	1.877	54	101
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	DRUNELLA	COLORADENSIS	⊥ S	97	1.986	28	55
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	DRUNELLA	DODDSI	-	11	1.032	2	2
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		⊥ S	39	1.596	30	47
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		SO	908	2.958	72	212
INSECTA	PLECOPTERA	NEMOURIDAE			⊥□	57	1.759	36	63
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA	CINCTIPES	- □	29	1.458	16	23
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA	OREGONENSIS	- □	484	2.685	16	42
INSECTA	PLECOPTERA	PERLODIDAE			⊥	25	1.400	48	67
INSECTA	PLECOPTERA	LEUCTRIDAE			- □	190	2.279	18	41
INSECTA	PLECOPTERA	CAPNIIDAE			⊥□	43	1.634	32	52
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE	GRANDIS	-	4	0.555	18	9
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	PARAPSYCHE	ELSIS	-	97	1.986	10	19
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA	HYALINATA	⊥	72	1.856	24	44
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA	ACROPEDES	⊥ C	90	1.953	72	140
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA	VAGRITA	⊥	22	1.333	30	39
INSECTA	TRICHOPTERA	LIMNEPHILIDAE				11	1.032	108	111
INSECTA	TRICHOPTERA	LIMNEPHILIDAE	NEOTHREMMA		⊥ S	86	1.935	24	46
INSECTA	DIPTERA	SIMULIIDAE			O	111	2.046	108	220
INSECTA	DIPTERA	CHIRONOMIDAE	TANYPODINAE		⊥	4	0.555	72	39
INSECTA	DIPTERA	CHIRONOMIDAE	ORTHOCLADIINAE		SO	936	2.971	108	320
INSECTA	DIPTERA	CERATOPOGONIDAE	BEZZIA		S	14	1.157	96	111
CRUSTACEA	COPEPODA					14	1.157	108	124
CRUSTACEA	OSTRACODA				S	72	1.856	108	200
OLIGOCHAETA	TUBIFICIDAE				SO	11	1.032	108	111
ARACHNIDA	HYDRACARINA				SO	441	2.645	98	259

MEAN BIOMASS GM/SQM: 2.1 TOTALS: 4887 3.689

FERRON CREEK

Station 1, at Forest Boundary - August 1, 1995

None of the taxa had good resident population numbers which often indicates some instability in an ecosystem. There were some indications of organic enrichment and sedimentation in this stream reach. Cleanwater taxa included just one mayfly species, *Rhithrogena*.

With a stream gradient of 3.0, this stream reach should have good maintenance capability. The DAT at this station was 6.7, which indicates fair biodiversity.

Compared to summer data from 1984-1986 and 1991 at Station 1, conditions in 1995 were not as good as found in 1984 or 1986 and were about the same as in 1991. BCI values indicated fair conditions in 1984 and 1986 (72-78) and poor conditions (60-65) in 1995. Biodiversity and biomass remained low, and numbers of organisms were lower than found in other years.

The potential for a fishery at this station appeared to be poor. The macroinvertebrate biomass of 0.2 g/m^2 would limit the number and size of fish that could be supported in this community and low numbers of cleanwater species indicated there could be limited spawning substrate in this stream reach. The large biennial stonefly, *Hesperoperla pacifica*, indicated by its 2-year nymphal stage that this remains a perennial stream and would be an important source of nutrients for the fishery, particularly for larger fish in the community.

The BCI of 65 indicated that poor conditions were present in this stream reach. It appeared that there may be opportunities for management to improve water quality, riparian habitat quality, and instream habitat quality in this aquatic ecosystem.

Station 1 - October 11, 1995

Low diversity and a lack of species with resident population numbers generally indicates instability. Non-selective species limitations indicate this could be related to flows. There were indications of some sedimentation at this station. Cleanwater taxa indicated fairly good water quality and some good instream substrate and included just one mayfly, *Rhithrogena*. With a stream gradient of 3.0, this stream reach should have good maintenance capability. The DAT at this station was 1.6, which indicates poor biodiversity.

Compared to fall data from 1984, 1986, and 1991 at Station 1, conditions in 1995 appeared similar (in the fair range) to those found in 1984 and 1986, and better than in 1991. BCI values indicated fair conditions (76-78) in 1984, 1986, and 1995, and poor conditions (66) in 1991. Biodiversity and biomass were lowest in 1995.

The potential for a fishery at this station appeared to be poor. The macroinvertebrate biomass of 0.1 g/m^2 would limit the number and size of fish that could be supported in this community. The clean water taxa present indicated that there could be some suitable spawning substrate.

The BCI of 78 indicated that fair conditions were present in this stream reach. It appeared that there may be opportunities for management to improve stability, water quality, riparian habitat quality, and instream habitat quality in this aquatic ecosystem.

MACROINVERTEBRATE ANALYSIS

Investigator: JILL DUFOUR
Forest/District: MANTI-LASAL NF/FERRON DISTRICT
Stream: FERRON CREEK
State/County: UTAH/EMERY COUNTY

Station	Location	Date	Diversity Index DAT (mean)	Standing Crop g/m^2 (mean)	Number of Organisms /m^2	Number of Taxa	Biotic Condition Index BCI 50
1		08 01 95	6.7	0.2	301	14	65
1		10 11 95	1.6	0.1	65	5	78
1		07 08 91	3.3	0.5	3,193	12	60
1		09 26 91	6.3	0.2	488	12	66
1		08 04 86	7.9	0.4	1,847	21	72
1		10 28 86	12.5	0.2	1,198	25	76
1		07 11 84	7.8	0.5	825	17	78
1		09 20 84	9.3	1.2	3,411	22	76

Scale	DAT	Standing Crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1 Ferron Creek, at Forest Bndry, Emery County, Manti-Lasal NF, Ferron District DATE: 8 1 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	14	301	137	466	151.24	28.97	50.18	2.6633	74	77

EPT Index is 32.14%.
EPT/Chironmidae is 0.90.
The Margalef Index of richness is 2.277.
The Menhinick Index of richness is 0.806.
Simpson's Diversity Index is 0.224.
Hill's Evenness Index is 0.705.
Shannon's Index is 1.846.
The Modified Hilsenhoff Tolerance Index is 3.778.
Percent contribution of dominant taxa is 86.90%.
Ratio of Scrapers to Collector-Gatherers is 0.259259.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.011905.
Ratio of Coll/Gath functional feeding group to total number of organisms is 0.964286.
Ratio of Filterer functional feeding group to total number of organisms is 0.321429.
Ratio of Scraper functional feeding group to total number of organisms is 0.250000.
Ratio of Predator functional feeding group to total number of organisms is 0.047619.
Ratio of Piercer functional feeding group to total number of organisms is 0.000000.

- = Clean Water Taxa
⊥ = Moderately Tolerant Taxa
D = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
U = Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Ferron Creek, at Forest Bndry, Emery County, Manti-Lasal NF, Ferron District DATE: 8 1 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE	MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		⊥	39	1.596	30	47
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		•	7	0.856	21	17
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	HEPTAGENIA		⊥ O	7	0.856	54	46
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	S	22	1.333	92	122
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		SO	4	0.555	72	39
INSECTA	PLECOPTERA	NEMOURIDAE	MALENKA		⊥□S	4	0.555	36	19
INSECTA	PLECOPTERA	PERLIDAE	HESPEROPERLA	PACIFICA	⊥ S U	4	0.555	30	16
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		S	11	1.032	108	111
INSECTA	COLEOPTERA	ELMIDAE			S	4	0.555	104	57
INSECTA	DIPTERA	SIMULIIDAE			O	86	1.935	108	208
INSECTA	DIPTERA	CHIRONOMIDAE	TANYPODINAE		⊥	4	0.555	72	39
INSECTA	DIPTERA	CHIRONOMIDAE	ORTHOCLADIINAE		SO	104	2.017	108	217
INSECTA	DIPTERA	EMPIDIDAE			S	4	0.555	95	52
NEMATODA					S	4	0.555	108	59

MEAN BIOMASS GM/SQM: 0.2 TOTALS: 301 2.479

TOTAL SAMPLE STATISTICS

STATION: 1 Ferron Creek, at Forest Bndry, Emery County, Manti-Lasal NF DATE: 10 11 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	5	65	54	76	10.07	9.01	15.60	2.1054	67	64

EPT Index is 77.78%.
EPT/Chironmidae is 3.50.
The Margalef Index of richness is 0.960.
The Menhinick Index of richness is 0.622.
Simpson's Diversity Index is 0.248.
Hill's Evenness Index is 0.939.
Shannon's Index is 1.459.
The Modified Hilsenhoff Tolerance Index is 4.000.
Percent contribution of dominant taxa is 100.00%.
Ratio of Scrapers to Collector-Gatherers is 0.090909.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.000000.
Ratio of Coll/Gath functional feeding group to total number of organisms is 0.611111.
Ratio of Filterer functional feeding group to total number of organisms is 0.166667.
Ratio of Scraper functional feeding group to total number of organisms is 0.055556.
Ratio of Predator functional feeding group to total number of organisms is 0.166667.
Ratio of Piercer functional feeding group to total number of organisms is 0.000000.

- = Clean Water Taxa
⊥ = Moderately Tolerant Taxa
D = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
Ū = Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Ferron Creek, at Forest Bndry, Emery County, Manti-Lasal NF DATE: 10 11 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE	MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		-	25	1.400	21	29
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		SO	4	0.555	72	39
INSECTA	PLECOPTERA	PERLODIDAE	ISOGENOIDES		⊥ S	11	1.032	30	30
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		S	11	1.032	108	111
INSECTA	DIPTERA	CHIRONOMIDAE			SO	14	1.157	108	124
				MEAN BIOMASS GM/SQM: 0.1	TOTALS:	65	1.810		

FISH CREEK

Station 1, riffle below Beaver Dam - October 9, 1995

The observed extremely low diversity and low numbers of organisms generally indicate instability. There were some indications of organic enrichment and sedimentation in this stream reach. Cleanwater taxa were not found.

The DAT at this station was 1.3, which indicates poor biodiversity. It appeared that the Beaver Dam which had been established just upstream of the sampling station has altered conditions in this stream reach. The potential for a fishery at this station appeared to be poor.

The BCI of 47 indicated that extreme stress conditions were present in this stream reach. Future samples should be taken in a selected riffle above or possibly downstream of this station.

MACROINVERTEBRATE ANALYSIS

Investigator: JILL DUFOUR
Forest/District: MANTI-LASAL NF/PRICE DISTRICT
Stream: FISH CREEK
State/County: UTAH/CARBON COUNTY

Station	Location	Date	Diversity Index DAT (mean)	Standing Crop g/m^2 (mean)	Number of Organisms /m^2	Number of Taxa	30Biotic Condition Index BCI 50
1		11 09 95	1.3	0.1	32	2	47
1		07 01 94	18.7	4.9	9,609	34	69
1		09 15 94	17.9	1.4	6,204	34	70
1		09 15 93	9.8	1.0	18,331	24	68
1		06 18 93	6.1	3.8	9,271	19	62
1		06 11 92	8.5	4.8	37,387	26	58
1		09 24 92	12.2	1.7	2,874	28	61
1		09 18 91	15.4	0.4	2,038	31	78
1		10 03 91	5.4	0.1	513	9	54
1		07 24 89	14.7	1.9	9,257	31	78
1		09 28 89	12.0	3.3	10,857	23	82
1		07 05 84	7.6	1.8	12,847	21	69
1		10 04 84	16.8	9.3	13,902		86

Scale	DAT	Standing Crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1 Fish Creek, Riffle bel. Beaver Dam, near Forest Bndry, Carbon County, Manti-Lasal NF DATE: 11 9 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	2	32	1	63	28.54	51.03	88.38	0.7642	108	107

EPT Index is 0.00%.
EPT/Chironmidae is 0.00.
The Margalef Index of richness is 0.288.
The Menhinick Index of richness is 0.352.
Simpson's Diversity Index is 0.643.
Hill's Evenness Index is 0.915.
Shannon's Index is 0.530.
The Modified Hilsenhoff Tolerance Index is 6.000.
Percent contribution of dominant taxa is 100.00%.
Ratio of Scrapers to Collector-Gatherers is 0.000000.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.000000.
Ratio of Coll/Gath functional feeding group to total number of organisms is 1.000000.
Ratio of Filterer functional feeding group to total number of organisms is 0.000000.
Ratio of Scraper functional feeding group to total number of organisms is 0.000000.
Ratio of Predator functional feeding group to total number of organisms is 0.000000.
Ratio of Piercer functional feeding group to total number of organisms is 0.000000.

- = Clean Water Taxa
⊥ = Moderately Tolerant Taxa
D = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
U = Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Fish Creek, Riffle bel. Beaver Dam, near Forest Bndry, Carbon County, Manti-Lasal NF DATE: 11 9 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE	MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	DIPTERA	CHIRONOMIDAE	ORTHOCLADIINAE		SO	25	1.400	108	151
OLIGOCHAETA	TUBIFICIDAE				SO	7	0.856	108	92
				MEAN BIOMASS GM/SQM: 0.1	TOTALS:	32	1.509		

LOWRY WATER CREEK

Station 1, - July 31, 1995

Low numbers of taxa and less than resident population numbers for the taxa present generally indicates instability in an ecosystem. Cleanwater taxa were missing from the community. With a stream gradient of 1.5, this stream reach should have good maintenance capability. The DAT at this station was 3.5, which indicates poor biodiversity. It appeared that grazing impacts had weakened this ecosystem which was unravelling during runoff because of unprotected banks.

Compared to summer data from 1984, 1986, and 1991 at Station 1, conditions in 1995 were not as good as in 1984 and 1986, and about the same as in 1991. BCI values indicated excellent conditions (92-94) in 1984 and 1986, severely stressed conditions (59) in 1991 and stressed conditions (61) in 1995. DAT values, biomass, numbers of organisms, and number of taxa were lowest in 1995.

The potential for a fishery at this station appeared to be poor. The macroinvertebrate biomass of 0.1 g/m^2 would severely limit the number and size of fish that could be supported in this community. The lack of clean water taxa indicated a probable lack of suitable spawning substrate in this stream reach.

The BCI of 61 indicated that stress conditions were present in this stream reach. It appeared that there may be opportunities for management to improve stability, water quality, riparian habitat quality, and instream habitat quality in this aquatic ecosystem.

Station 1, October 12, 1995

The observed low biodiversity and less than resident population numbers for any of the taxa generally indicates instability in an ecosystem. There were indications of some sedimentation at this station. Cleanwater taxa indicated fairly good water quality and some good instream substrate and included *Rhithrogena, Cultus,* and *Arctopsyche grandis.*

The observed number of shredders in the community is generally found where the riparian habitat is in poor condition or where instream habitat conditions are not suitable for these species. The DAT at this station was 5.9, which indicates fair biodiversity.

Compared to fall data from 1984, 1986, and 1991 at Station 1, conditions in 1995 appeared better than in 1991 yet not as good as in 1984 or 1986. BCI values indicated excellent conditions (100) in 1984 and 1986, poor conditions (65) in 1991, and fair conditions (77) in 1995. Most of the analysis elements had lower values in 1995; see Analysis Data Table.

The potential for a fishery at this station appeared to be poor. The macroinvertebrate biomass of 0.1 g/m^2 would severely limit the number and size of fish that could be supported in this community. The clean water taxa present indicated that there could be some suitable spawning substrate.

The BCI of 77 indicated that fair conditions were present in this stream reach. It appeared that there may be opportunities for management to improve stability, water quality, riparian habitat quality, and instream habitat quality in this aquatic ecosystem.

MACROINVERTEBRATE ANALYSIS

Investigator: JILL DUFOUR
Forest/District: MANTI-LASAL NF/FERRON DISTRICT
Stream: LOWRY WATER CREEK
State/County: UTAH/EMERY COUNTY

Station	Location	Date	Diversity Index DAT (mean)	Standing Crop g/m^2 (mean)	Number of Organisms $/m^2$	Number of Taxa	Biotic Condition Index BCI 50
1		07 31 95	3.5	0.1	68	9	61
1		10 12 95	5.9	0.1	176	10	77
1		07 09 91	10.1	1.1	2,307	20	59
1		10 02 91	6.3	0.2	5,032	18	65
1		08 04 86	13.0	0.9	2,902	30	92
1		10 28 86	14.8	0.9	19,253	32	100
1		07 19 84	13.6	1.3	2,410	22	94
1		09 19 84	13.0	0.9	1,223	24	100

Scale	DAT	Standing Crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1 Lowry Water Creek, Emery County, Manti-Lasal NF, Ferron District DATE: 7 31 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	9	68	35	101	30.17	25.55	44.26	2.9966	80	82

EPT Index is 52.63%.
EPT/Chironmidae is 3.33.
The Margalef Index of richness is 1.895.
The Menhinick Index of richness is 1.090.
Simpson's Diversity Index is 0.123.
Hill's Evenness Index is 1.020.
Shannon's Index is 2.077.
The Modified Hilsenhoff Tolerance Index is 3.714.
Percent contribution of dominant taxa is 78.95%.
Ratio of Scrapers to Collector-Gatherers is 0.444444.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.000000.
Ratio of Coll/Gath functional feeding group to total number of organisms is 0.947368.
Ratio of Filterer functional feeding group to total number of organisms is 0.473684.
Ratio of Scraper functional feeding group to total number of organisms is 0.421053.
Ratio of Predator functional feeding group to total number of organisms is 0.052632.
Ratio of Piercer functional feeding group to total number of organisms is 0.000000.

- = Clean Water Taxa
⊥ = Moderately Tolerant Taxa
□ = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
Ū = Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Lowry Water Creek, Emery County, Manti-Lasal NF, Ferron District DATE: 7 31 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE	MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		SO	11	1.032	72	74
INSECTA	PLECOPTERA	PERLODIDAE	ISOGENOIDES		⊥ S	4	0.555	30	16
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		S	11	1.032	108	111
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	BRACHYCENTRUS	AMERICANUS	⊥ S	11	1.032	48	49
INSECTA	COLEOPTERA	ELMIDAE			S	4	0.555	104	57
INSECTA	COLEOPTERA	ELMIDAE	OPTIOSERVUS		S	4	0.555	104	57
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA	MONTICOLA	⊥ S	4	0.555	40	22
INSECTA	DIPTERA	SIMULIIDAE			O	11	1.032	108	111
INSECTA	DIPTERA	CHIRONOMIDAE	ORTHOCLADIINAE		SO	11	1.032	108	111

MEAN BIOMASS GM/SQM: 0.1 TOTALS: 68 1.834

TOTAL SAMPLE STATISTICS

STATION: 1 Lowry Water Creek, Emery County, Manti-Lasal NF, Ferron District DATE: 10 12 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	10	176	0	384	190.84	62.67	108.55	2.7836	60	65

EPT Index is 53.06%.
EPT/Chironmidae is 1.44.
The Margalef Index of richness is 1.741.
The Menhinick Index of richness is 0.754.
Simpson's Diversity Index is 0.192.
Hill's Evenness Index is 0.755.
Shannon's Index is 1.929.
The Modified Hilsenhoff Tolerance Index is 2.875.
Percent contribution of dominant taxa is 81.63%.
Ratio of Scrapers to Collector-Gatherers is 0.341463.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.000000.
Ratio of Coll/Gath functional feeding group to total number of organisms is 0.836735.
Ratio of Filterer functional feeding group to total number of organisms is 0.183673.
Ratio of Scraper functional feeding group to total number of organisms is 0.285714.
Ratio of Predator functional feeding group to total number of organisms is 0.204082.
Ratio of Piercer functional feeding group to total number of organisms is 0.000000.

▪ = Clean Water Taxa
⊥ = Moderately Tolerant Taxa
□ = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
Ū = Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Lowry Water Creek, Emery County, Manti-Lasal NF, Ferron District DATE: 10 12 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE		MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		-		18	1.254	21	26
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	DRUNELLA	GRANDIS	⊥	S	25	1.400	32	44
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS			SO	7	0.856	72	61
INSECTA	PLECOPTERA	CHLOROPERLIDAE			⊥		7	0.856	24	20
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS		-		4	0.555	12	6
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE			S	25	1.400	108	151
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE	GRANDIS	-		7	0.856	18	15
INSECTA	COLEOPTERA	ELMIDAE				S	11	1.032	104	107
INSECTA	DIPTERA	CHIRONOMIDAE	CHIRONOMINI			SO	65	1.810	108	195
OLIGOCHAETA	TUBIFICIDAE					SO	7	0.856	108	92

MEAN BIOMASS GM/SQM: 0.1 TOTALS: 176 2.245

MUDDY CREEK

Station 1, at Forest Bndry - August 1, 1995

Most of the taxa had less than resident population numbers which generally indicates instability. Sediment tolerant taxa had fairly good biodiversity in the community. There were indications of sedimentation at this station. Cleanwater taxa included *Epeorus* and *Amphicosmoecus*, but each had extremely low numbers which indicated they were not successfully living under existing conditions. With a stream gradient of 2.0, this stream reach should have good maintenance capability. The DAT at this station was 7.9, which indicates fair biodiversity.

Compared to summer data from 1984, 1986, and 1991 at Station 1, conditions in 1995 were not as good as in 1984 or 1986, but better than in 1991. BCI values indicated fair conditions (73-78) in 1984 and 1986, poor conditions (61) in 1991 and (63) in 1995. Most of the analysis elements were higher than found in prior years; see Analysis Data Table.

The potential for a resident fishery at this station appeared to be poor. The macroinvertebrate biomass of 0.9 g/m² would limit the number and size of fish that could be supported in this community and the scarcity of cleanwater species indicated limited spawning substrate in this stream reach.

The BCI of 63 indicated that poor conditions were present in this stream reach. It appeared that there may be opportunities for management to improve water quality, riparian habitat quality, and instream habitat quality in this aquatic ecosystem.

Station 1 - October 11, 1995

The observed extremely low biodiversity and low population numbers for taxa present is generally found where there has been instability in an ecosystem. This could have been due to the high scouring flows in this drainage. Cleanwater taxa were missing. The DAT at this station was 1.0, which indicates extremely poor biodiversity.

Compared to fall data from 1984, 1986, and 1991 at Station 1, conditions in 1995 appeared more stressed than in some prior years. Analysis elements have generally indicated stressed conditions in this ecosystem. In 1995 the BCI value of 75 indicated fair conditions but was based upon taxa with less than resident population numbers.

The potential for a fishery at this station appeared to be poor. The macroinvertebrate biomass of 0.1 g/m^2 would severely limit the number and size of fish that could be supported in this community. The lack of clean water taxa indicated stressed conditions in this ecosystem.

The BCI of 75 indicated that fair conditions were present in this stream reach. It appeared that there may be opportunities for management to improve water quality, riparian habitat quality, and instream habitat quality in this aquatic ecosystem.

MACROINVERTEBRATE ANALYSIS

Investigator: JILL DUFOUR
Forest/District: MANTI-LASAL NF/FERRON DISTRICT
Stream: MUDDY CREEK
State/County: UTAH/EMERY COUNTY

Station	Location	Date	Diversity Index DAT (mean)	Standing Crop g/m^2 (mean)	Number of Organisms /m^2	Number of Taxa	Biotic Condition Index BCI 50
1		08 01 95	7.9	0.9	983	22	63
1		10 11 95	1.0	0.1	25	4	75
1		07 25 91	4.1	0.1	370	10	61
1		09 26 91	5.6	0.6	255	14	65
1		08 04 86	3.6	0.3	635	13	73
1		10 28 86	3.0	0.2	136	6	93
1		07 11 84	3.2	0.3		12	78
1		09 19 84	3.7	0.1	560	10	60

Scale	DAT	Standing Crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1 Muddy Creek, at Forest Bndry, Emery County, Manti-Lasal NF, Ferron District DATE: 8 1 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	22	983	405	1561	530.83	31.17	54.00	2.1341	71	80

EPT Index is 39.42%.
EPT/Chironmidae is 0.79.
The Margalef Index of richness is 3.048.
The Menhinick Index of richness is 0.702.
Simpson's Diversity Index is 0.360.
Hill's Evenness Index is 0.633.
Shannon's Index is 1.479.
The Modified Hilsenhoff Tolerance Index is 3.692.
Percent contribution of dominant taxa is 89.78%.
Ratio of Scrapers to Collector-Gatherers is 0.392000.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.007299.
Ratio of Coll/Gath functional feeding group to total number of organisms is 0.912409.
Ratio of Filterer functional feeding group to total number of organisms is 0.021898.
Ratio of Scraper functional feeding group to total number of organisms is 0.357664.
Ratio of Predator functional feeding group to total number of organisms is 0.069343.
Ratio of Piercer functional feeding group to total number of organisms is 0.003650.

* = Clean Water Taxa
⊥ = Moderately Tolerant Taxa
D = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
U = Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Muddy Creek, at Forest Bndry, Emery County, Manti-Lasal NF, Ferron District DATE: 8 1 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE	MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		▪	4	0.555	18	9
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		⊥	7	0.856	30	25
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	S	323	2.509	92	230
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	DRUNELLA	GRANDIS	⊥ S	4	0.555	32	17
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		SO	7	0.856	72	61
INSECTA	PLECOPTERA	NEMOURIDAE	MALENKA		⊥□S	4	0.555	36	19
INSECTA	PLECOPTERA	PERLODIDAE	ISOGENOIDES		⊥ S	4	0.555	30	16
INSECTA	TRICHOPTERA					22	1.333	72	95
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		S	7	0.856	108	92
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA	HYALINATA	⊥	4	0.555	24	13
INSECTA	TRICHOPTERA	LIMNEPHILIDAE	AMPHICOSMOECUS		▪ □	4	0.555	18	9
INSECTA	COLEOPTERA	ELMIDAE			S	4	0.555	104	57
INSECTA	COLEOPTERA	ELMIDAE	OPTIOSERVUS		S	4	0.555	104	57
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA		⊥ S	4	0.555	36	19
INSECTA	DIPTERA	SIMULIIDAE			O	14	1.157	108	124
INSECTA	DIPTERA	CHIRONOMIDAE	ORTHOCLADIINAE		SO	492	2.692	108	290
INSECTA	DIPTERA	EMPIDIDAE			S	14	1.157	95	109
INSECTA	DIPTERA	EMPIDIDAE	HEMERODROMIA		S	11	1.032	95	98
INSECTA	DIPTERA	EMPIDIDAE	CHELIFERA		S	25	1.400	95	132
INSECTA	DIPTERA	CERATOPOGONIDAE	BEZZIA		S	4	0.555	96	53
OLIGOCHAETA	TUBIFICIDAE				SO	22	1.333	108	143
ARACHNIDA	HYDRACARINA				SO	4	0.555	98	54

MEAN BIOMASS GM/SQM: 0.9 TOTALS: 983 2.993

TOTAL SAMPLE STATISTICS

STATION: 1 Muddy Creek, at Forest Bndry, Emery County, Manti-Lasal NF DATE: 10 11 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	4	25	0	71	42.15	96.90	167.84	1.6645	67	67

EPT Index is 85.71%.
EPT/Chironmidae is 6.00.
The Margalef Index of richness is 0.931.
The Menhinick Index of richness is 0.798.
Simpson's Diversity Index is 0.362.
Hill's Evenness Index is 0.871.
Shannon's Index is 1.154.
The Modified Hilsenhoff Tolerance Index is 4.000.
Percent contribution of dominant taxa is 100.00%.
Ratio of Scrapers to Collector-Gatherers is 0.833333.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.142857.
Ratio of Coll/Gath functional feeding group to total number of organisms is 0.857143.
Ratio of Filterer functional feeding group to total number of organisms is 0.000000.
Ratio of Scraper functional feeding group to total number of organisms is 0.714286.
Ratio of Predator functional feeding group to total number of organisms is 0.142857.
Ratio of Piercer functional feeding group to total number of organisms is 0.000000.

- = Clean Water Taxa
⊥ = Moderately Tolerant Taxa
D = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
U = Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Muddy Creek, at Forest Bndry, Emery County, Manti-Lasal NF DATE: 10 11 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE	MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	HEPTAGENIA		⊥ O	4	0.555	54	29
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		SO	14	1.157	72	83
INSECTA	PLECOPTERA	NEMOURIDAE			⊥Ω	4	0.555	36	19
INSECTA	DIPTERA	CHIRONOMIDAE	ORTHOCLADIINAE		SO	4	0.555	108	59
				MEAN BIOMASS GM/SQM: 0.0	TOTALS:	25	1.400		

Station 1 - July 31, 1995

There were some indications of sediment in this stream reach. Cleanwater taxa included *Epeorus, Drunella doddsi,* and *Zapada cinctipes*, but none had resident population numbers. With a stream gradient of 2.0, this stream reach should have good maintenance capability. The DAT at this station was 11.6, which indicates good biodiversity.

Compared to summer data from 1994 at Station 1, conditions in 1995 appeared to be close to the same. Biodiversity and numbers of organisms were lower in 1995.

The potential for a fishery at this station appeared to be fair. The macroinvertebrate biomass of 1.9 g/m² could provide nutrients for a fairly good fishery. However, the scarcity of cleanwater species indicated there could be limited spawning substrate in this stream reach.

The BCI of 77 indicated that fair conditions were present in this stream reach. It appeared that there may be opportunities for management to improve instream habitat quality in this aquatic ecosystem.

Station 1 - October 12, 1995

There were some indications of sediment in this ecosystem. Cleanwater taxa indicated relatively good water quality and some good instream substrate and included *Rhithrogena, Drunella doddsi, Zapada cinctipes,* and *Cultus*.

The observed number of shredders in the community is generally found where the riparian habitat is in at least fair condition. The DAT at this station was 16.9, which indicates good biodiversity.

Compared to fall data from 1993 and 1994 at Station 1, conditions in 1995 were about the same as in 1993 and similar to those found in 1994. BCI values indicated fairly good conditions (82-83) in 1993 and 1995, and fair conditions (79) in 1994.

The potential for a fishery at this station appeared to be fair. The macroinvertebrate biomass of 0.6 g/m² would limit the number and size of fish that could be supported in this community. Cleanwater species present indicated there could be some suitable spawning substrate in this stream reach.

The BCI of 82 indicated that this stream reach was in fairly good condition but could be better. It appeared that there may be opportunities for management to improve instream habitat quality and possibly riparian habitat quality in this aquatic ecosystem.

MACROINVERTEBRATE ANALYSIS

Investigators: JILL DUFOUR
Forest/District: MANTI-LASAL NF/PRICE DISTRICT
Stream: NUCKWOODWARD CREEK
State/County: UTAH/EMERY COUNTY

Station	Location	Date	Diversity Index DAT (mean)	Standing Crop g/m^2 (mean)	Number of Organisms $/m^2$	Number of Taxa	Biotic Condition Index BCI 53
1	*	07 31 95	11.6	1.9	1,568	26	77
1		10 12 95	16.9	0.6	1,808	36	82
1		06 27 94	16.2	1.3	7,506	38	79
1		09 23 94	19.0	1.4	6,473	40	79
1		09 13 93	15.6	0.6	6,588	32	83

* Vicinity of Cyprus-Plateau Mine

Scale	DAT	Standing Crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1 Nuck Woodward Creek, Emery County, Manti-Lasal NF, Price District DATE: 7 31 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	26	1568	753	2383	748.37	27.56	47.73	3.2198	68	69

EPT Index is 35.47%.
EPT/Chironmidae is 2.42.
The Margalef Index of richness is 3.398.
The Menhinick Index of richness is 0.657.
Simpson's Diversity Index is 0.152.
Hill's Evenness Index is 0.705.
Shannon's Index is 2.232.
The Modified Hilsenhoff Tolerance Index is 3.500.
Percent contribution of dominant taxa is 78.72%.
Ratio of Scrapers to Collector-Gatherers is 0.526761.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.018307.
Ratio of Coll/Gath functional feeding group to total number of organisms is 0.812357.
Ratio of Filterer functional feeding group to total number of organisms is 0.004577.
Ratio of Scraper functional feeding group to total number of organisms is 0.427918.
Ratio of Predator functional feeding group to total number of organisms is 0.171625.
Ratio of Piercer functional feeding group to total number of organisms is 0.000000.

* = Clean Water Taxa
⊥ = Moderately Tolerant Taxa
D = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
U = Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Nuck Woodward Creek, Emery County, Manti-Lasal NF, Price District DATE: 7 31 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE	MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		-	4	0.555	18	9
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		⊥	158	2.198	30	65
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	DRUNELLA	COLORADENSIS	⊥ S	215	2.333	28	65
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	DRUNELLA	DODDSI	-	4	0.555	2	1
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	SERRATELLA	TIBIALIS	⊥	72	1.856	24	44
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		SO	61	1.785	72	128
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA	CINCTIPES	- □	4	0.555	16	8
INSECTA	PLECOPTERA	PERLODIDAE			⊥	14	1.157	48	55
INSECTA	TRICHOPTERA					4	0.555	72	39
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA	ACROPEDES	⊥ C	4	0.555	72	39
INSECTA	TRICHOPTERA	LIMNEPHILIDAE	DICOSMOECUS		⊥□	18	1.254	24	30
INSECTA	COLEOPTERA	ELMIDAE			S	18	1.254	104	130
INSECTA	COLEOPTERA	ELMIDAE	ZAITZEVIA		S	179	2.254	104	234
INSECTA	DIPTERA	TIPULIDAE	ORMOSIA		S	11	1.032	72	74
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA		⊥ S	11	1.032	36	37
INSECTA	DIPTERA	TIPULIDAE	TIPULA		□SO	7	0.856	80	68
INSECTA	DIPTERA	CHIRONOMIDAE	ORTHOCLADIINAE		SO	230	2.361	108	254
INSECTA	DIPTERA	EMPIDIDAE			S	4	0.555	95	52
INSECTA	DIPTERA	EMPIDIDAE	CHELIFERA		S	4	0.555	95	52
INSECTA	DIPTERA	CERATOPOGONIDAE	BEZZIA		S	4	0.555	96	53
INSECTA	DIPTERA	CERATOPOGONIDAE	FORCIPMOMYIA		S	4	0.555	90	49
GASTROPODA	LYMNAEIDAE	LYMNAEA			O	4	0.555	108	59
PELECYPODA					S	7	0.856	108	92
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA		O	452	2.655	90	238
OLIGOCHAETA	TUBIFICIDAE				SO	68	1.834	108	198
OLIGOCHAETA	LUMBRICIDAE				SO	11	1.032	90	92

MEAN BIOMASS GM/SQM: 1.9 TOTALS: 1568 3.195

TOTAL SAMPLE STATISTICS

STATION: 1 Nuck Woodward Creek, Emery County, Manti-Lasal NF, Price District DATE: 10 12 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	36	1808	116	3500	1554.00	49.61	85.93	3.7688	65	65

EPT Index is 40.08%.
EPT/Chironmidae is 2.15.
The Margalef Index of richness is 4.667.
The Menhinick Index of richness is 0.847.
Simpson's Diversity Index is 0.128.
Hill's Evenness Index is 0.574.
Shannon's Index is 2.612.
The Modified Hilsenhoff Tolerance Index is 3.789.
Percent contribution of dominant taxa is 63.29%.
Ratio of Scrapers to Collector-Gatherers is 0.679825.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.003968.
Ratio of Coll/Gath functional feeding group to total number of organisms is 0.904762.
Ratio of Filterer functional feeding group to total number of organisms is 0.005952.
Ratio of Scraper functional feeding group to total number of organisms is 0.615079.
Ratio of Predator functional feeding group to total number of organisms is 0.210317.
Ratio of Piercer functional feeding group to total number of organisms is 0.001984.

* = Clean Water Taxa
⊥ = Moderately Tolerant Taxa
D = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
Ū = Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Nuck Woodward Creek, Emery County, Manti-Lasal NF, Price District DATE: 10 12 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE	MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE			⊥	4	0.555	48	26
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		⊥	83	1.917	30	57
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		-	4	0.555	21	11
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	HEPTAGENIA		⊥ O	75	1.877	54	101
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	S	126	2.099	92	193
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	DRUNELLA	GRANDIS	⊥ S	7	0.856	32	27
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	DRUNELLA	DODDSI	-	32	1.509	2	3
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		SO	47	1.669	72	120
INSECTA	EPHEMEROPTERA	SIPHLONURIDAE	AMELETUS		S	7	0.856	72	61
INSECTA	PLECOPTERA	CHLOROPERLIDAE			⊥	57	1.759	24	42
INSECTA	PLECOPTERA	NEMOURIDAE			⊥□	4	0.555	36	19
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA	CINCTIPES	- □	4	0.555	16	8
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS		-	25	1.400	12	16
INSECTA	PLECOPTERA	PERLODIDAE	MEGARCYS		⊥ S	43	1.634	30	49
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA		⊥ S	11	1.032	48	49
INSECTA	TRICHOPTERA					7	0.856	72	61
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA	ACROPEDES	⊥ C	11	1.032	72	74
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA	VAGRITA	⊥	100	2.002	30	60
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	MICRASEMA		⊥ S	22	1.333	24	31
INSECTA	TRICHOPTERA	HYDROPTILIDAE	HYDROPTILA		S	4	0.555	108	59
INSECTA	TRICHOPTERA	LIMNEPHILIDAE				4	0.555	108	59
INSECTA	TRICHOPTERA	LIMNEPHILIDAE	OLIGOPHLEBODES		⊥ S	50	1.701	30	51
INSECTA	COLEOPTERA	ELMIDAE			S	50	1.701	104	176
INSECTA	COLEOPTERA	ELMIDAE	ZAITZEVIA		S	492	2.692	104	279
INSECTA	COLEOPTERA	ELMIDAE	OPTIOSERVUS		S	90	1.953	104	203
INSECTA	DIPTERA	TIPULIDAE	ORMOSIA		S	4	0.555	72	39
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		⊥ S	7	0.856	36	30
INSECTA	DIPTERA	SIMULIIDAE			O	7	0.856	108	92
INSECTA	DIPTERA	CHIRONOMIDAE	ORTHOCLADIINAE		SO	337	2.528	108	273
INSECTA	DIPTERA	EMPIDIDAE	CHELIFERA		S	11	1.032	95	98
INSECTA	DIPTERA	CERATOPOGONIDAE	ATRICHOPOGON		S	7	0.856	90	77
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA		S C	22	1.333	86	114
PELECYPODA					S	4	0.555	108	59
OLIGOCHAETA	TUBIFICIDAE				SO	39	1.596	108	172
OLIGOCHAETA	LUMBRICIDAE				SO	11	1.032	90	92
NEMATODA					S	4	0.555	108	59

MEAN BIOMASS GM/SQM: 0.6 TOTALS: 1808 3.257

SEELEY CREEK

Station 1, Rd xing above Joe's Res. - July 31, 1995

There were indications of some sediment in this ecosystem. The observed low biodiversity and taxa without resident population numbers often indicates instability. This may have been due, in part, to the scouring action of high waters and difficult (highwater) sampling conditions. Cleanwater taxa indicated fairly good water quality and some good instream substrate and included *Epeorus, Rhithrogena,* and Leuctridae. With a stream gradient of 2.0, this stream reach should have good maintenance capability. The DAT at this station was 5.6, which indicates fair biodiversity.

Compared to summer data from 1991 at Station 1, conditions in 1995 appeared more limiting. The BCI values indicated fair conditions (74) in 1991 and fairly good conditions (83) in 1995. However, other analysis elements indicated more stress in the community. In 1995 biomass, DAT, and numbers of taxa and organisms were lower; see Analysis Data Table.

The potential for a fishery at this station appeared to be poor. The macroinvertebrate biomass of 0.2 g/m^2 would limit the number and size of fish that could be supported in this community. The clean water taxa present indicated that there could be some suitable spawning substrate.

The BCI of 83 indicated that this stream reach was in fairly good condition but could be better. It appeared that there may be opportunities for management to improve stability, water quality, riparian habitat quality, and instream habitat quality in this aquatic ecosystem.

Station 1 - October 12, 1995

The observed low biodiversity and less than resident population numbers for most of the taxa generally indicates instability. There were indications of sedimentation and organic enrichment in this stream reach. Cleanwater taxa were missing.

The observed number of shredders in the community is generally found where the riparian habitat is in poor condition or where instream habitat conditions are not suitable for these species. The DAT at this station was 2.4, which indicates poor biodiversity.

Compared to fall data from 1991 at Station 1, conditions in 1995 did not appear as good. All of the analysis elements in 1995 indicated more stressed conditions. The BCI dropped from fair (78) in 1991 to poor (63) in 1995.

The potential for a fishery at this station appeared to be poor. The macroinvertebrate biomass of 0.1 g/m^2 would severely limit the number and size of fish that could be supported in this community and the lack of cleanwater species indicated limited spawning substrate in this stream reach.

The BCI of 63 indicated that poor conditions were present in this stream reach. The macroinvertebrate community indicated there may be opportunities for management to improve stability, water quality, riparian habitat quality, and instream habitat quality in this aquatic ecosystem.

MACROINVERTEBRATE ANALYSIS

Investigator: JILL DUFOUR
Forest/District: MANTI-LASAL NF/FERRON DISTRICT
Stream: SEELEY CREEK
State/County: UTAH/EMERY COUNTY

Station	Location	Date	Diversity Index DAT (mean)	Standing Crop g/m^2 (mean)	Number of Organisms /m^2	Number of Taxa	Biotic Condition Index BCI 50
1		07 31 95	5.6	0.2	158	13	83
1		10 12 95	2.4	0.1	266	8	63
1		07 09 91	13.7	0.5	1,654	27	74
1		09 26 91	12.7	1.0	7,047	29	78

Scale	DAT	Standing Crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1 Seeley Creek, Rd xing Abv. Joe's Res., Emery County, Manti-Lasal NF, Ferron District DATE: 7 31 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	13	158	14	302	132.06	48.30	83.65	2.9511	61	60

EPT Index is 77.27%.
EPT/Chironmidae is 11.33.
The Margalef Index of richness is 2.371.
The Menhinick Index of richness is 1.035.
Simpson's Diversity Index is 0.187.
Hill's Evenness Index is 0.691.
Shannon's Index is 2.046.
The Modified Hilsenhoff Tolerance Index is 3.111.
Percent contribution of dominant taxa is 77.27%.
Ratio of Scrapers to Collector-Gatherers is 0.789474.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.068182.
Ratio of Coll/Gath functional feeding group to total number of organisms is 0.863636.
Ratio of Filterer functional feeding group to total number of organisms is 0.159091.
Ratio of Scraper functional feeding group to total number of organisms is 0.681818.
Ratio of Predator functional feeding group to total number of organisms is 0.090909.
Ratio of Piercer functional feeding group to total number of organisms is 0.022727.

- = Clean Water Taxa
- = Moderately Tolerant Taxa
- = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
- = Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Seeley Creek, Rd xing Abv. Joe's Res., Emery County, Manti-Lasal Nf, Ferron District DATE: 7 31 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE	MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		-	57	1.759	18	31
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		-	4	0.555	21	11
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	HEPTAGENIA		⊥ O	7	0.856	54	46
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	DRUNELLA	GRANDIS	⊥ S	4	0.555	32	17
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		SO	29	1.458	72	104
INSECTA	PLECOPTERA	PERLODIDAE			⊥	4	0.555	48	26
INSECTA	PLECOPTERA	LEUCTRIDAE			- □	7	0.856	18	15
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	BRACHYCENTRUS	AMERICANUS	⊥ S	7	0.856	48	41
INSECTA	TRICHOPTERA	LIMNEPHILIDAE	HESPEROPHYLAX		□SO	4	0.555	108	59
INSECTA	DIPTERA	SIMULIIDAE			O	18	1.254	108	135
INSECTA	DIPTERA	CHIRONOMIDAE	CHIRONOMINI		SO	11	1.032	108	111
INSECTA	DIPTERA	AHTERICIDAE	ATHERIX		S C	4	0.555	66	36
ARACHNIDA	HYDRACARINA				SO	4	0.555	98	54

MEAN BIOMASS GM/SQM: 0.2 TOTALS: 158 2.198

TOTAL SAMPLE STATISTICS

STATION: 1 Seeley Creek, at Road xing abv. Joe's Res., Emery County, Manti-Lasal NF DATE: 10 12 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	8	266	30	501	216.56	47.09	81.56	0.9922	79	79

EPT Index is 8.11%.
EPT/Chironmidae is 0.1.
The Margalef Index of richness is 1.254.
The Menhinick Index of richness is 0.491.
Simpson's Diversity Index is 0.728.
Hill's Evenness Index is 0.691.
Shannon's Index is 0.688.
The Modified Hilsenhoff Tolerance Index is 3.857.
Percent contribution of dominant taxa is 95.95%.
Ratio of Scrapers to Collector-Gatherers is 0.073529.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.040541.
Ratio of Coll/Gath functional feeding group to total number of organisms is 0.918919.
Ratio of Filterer functional feeding group to total number of organisms is 0.040541.
Ratio of Scraper functional feeding group to total number of organisms is 0.067568.
Ratio of Predator functional feeding group to total number of organisms is 0.013514.
Ratio of Piercer functional feeding group to total number of organisms is 0.000000.

- = Clean Water Taxa
⊥ = Moderately Tolerant Taxa
□ = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
U = Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Seeley Creek, at Road xing abv. Joe's Res., Emery County, Manti-Lasal NF DATE: 10 12 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE	MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	BRACHYCENTRUS	AMERICANUS	⊥ S	11	1.032	48	49
INSECTA	TRICHOPTERA	LEPIDOSTOMATIDAE	LEPIDOSTOMA		⊥□	11	1.032	24	24
INSECTA	COLEOPTERA	ELMIDAE	ZAITZEVIA		S	4	0.555	104	57
INSECTA	COLEOPTERA	PSEPHENIDAE	PSEPHENUS		S	4	0.555	72	39
INSECTA	DIPTERA	CHIRONOMIDAE	ORTHOCLADIINAE		SO	226	2.354	108	254
INSECTA	DIPTERA	CERATOPOGONIDAE	BEZZIA		S	4	0.555	96	53
INSECTA	LEPIDOPTERA	PYRALIDAE	PETROPHILA		S	4	0.555	72	39
OLIGOCHAETA	TUBIFICIDAE				SO	4	0.555	108	59

MEAN BIOMASS GM/SQM: 0.1 TOTALS: 266 2.424

STRAIGHT CANYON CREEK

Station 1 - August 1, 1995

None of the taxa had strong resident population numbers, which indicated possible instability. This could be from scouring flows, or rock embeddedness in the stream bed. There were some indications of organic enrichment and sedimentation in this stream reach. Cleanwater taxa were missing from the community.

The observed number of shredders in the community is generally found where the riparian habitat is in at least fair condition or where instream habitat conditions are not suitable for these species. With a stream gradient of 2.0, this stream reach should have good maintenance capability. The DAT at this station was 8.7, which indicates fair biodiversity.

Compared to summer data from 1984, 1986, and 1991 at Station 1, conditions in 1995 appeared better than in 1984 or 1991, and about the same as in 1986. BCI values have indicated poor conditions (66-67) in 1984 and 1991, and fair conditions (72-74) in 1986 and 1995.

The potential for a fishery at this station appeared to be poor. The macroinvertebrate biomass of 0.3 g/m^2 would limit the number and size of fish that could be supported in this community and the lack of cleanwater species indicated limited spawning substrate in this stream reach.

The BCI of 74 indicated that fair conditions were present in this stream reach. The macroinvertebrate community indicated that there may be opportunities for management to improve water quality, riparian habitat quality, and instream habitat quality in this aquatic ecosystem.

Station 1 - October 12, 1995

The observed low biodiversity and lack of resident population numbers for any of the taxa generally indicates instability. This may have been due, in part, to difficult sampling conditions because of high water flows. There were indications of some sedimentation at this station. Cleanwater taxa were missing. The DAT at this station was 3.3, which indicates poor biodiversity.

Compared to fall data from 1984, 1986, and 1991 at Station 1, conditions in 1995 were still limiting. Although the BCI indicated good conditions (85), this was based upon taxa with less than resident population numbers. All of the other analysis elements were low and indicated limiting conditions.

The potential for a fishery at this station appeared to be poor. The macroinvertebrate biomass of 0.1 g/m^2 would limit the number and size of fish that could be supported in this community. The lack of clean water taxa indicated a possible lack of suitable spawning substrate. The large biennial stonefly, *Hesperoperla pacifica*, indicated by its 2-year nymphal stage that this remains a perennial stream and would be an important source of nutrients for the fishery, particularly for larger fish in the community.

The BCI of 85 indicated that this stream reach was in good condition but was based upon a community that was not successfully living in this ecosystem. It appeared that there may be opportunities for management to improve water quality, riparian habitat quality, and instream habitat quality in this aquatic ecosystem.

MACROINVERTEBRATE ANALYSIS

Investigator: JILL DUFOUR
Forest/District: MANTI-LASAL NF/FERRON DISTRICT
Stream: STRAIGHT CANYON CREEK
State/County: UTAH/EMERY COUNTY

Station	Location	Date	Diversity Index DAT (mean)	Standing Crop g/m^2 (mean)	Number of Organisms /m^2	Number of Taxa	Biotic Condition Index BCI 53
1		08 01 95	8.7	0.3	513	19	74
1		10 12 95	3.3	0.1	47	9	85
1		07 08 91	11.6	0.7	2,809	27	66
1		10 02 91	10.7	0.6	4,962	26	66
1		08 04 86	9.7	0.6	4,942	21	72
1		10 28 86	5.2	2.0	19,777	17	72
1		07 19 84	5.1	0.4	1,442	20	67
1		09 19 84	7.3	0.3	34,844	24	60

Scale	DAT	Standing Crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1 Straight Canyon Creek, Emery County, Manti-Lasal NF, Ferron District DATE: 8 1 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	19	513	96	931	383.39	43.14	74.72	2.9770	65	72

EPT Index is 39.86%.
EPT/Chironmidae is 1.06.
The Margalef Index of richness is 2.884.
The Menhinick Index of richness is 0.839.
Simpson's Diversity Index is 0.201.
Hill's Evenness Index is 0.633.
Shannon's Index is 2.063.
The Modified Hilsenhoff Tolerance Index is 2.643.
Percent contribution of dominant taxa is 81.82%.
Ratio of Scrapers to Collector-Gatherers is 0.387597.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.055944.
Ratio of Coll/Gath functional feeding group to total number of organisms is 0.902098.
Ratio of Filterer functional feeding group to total number of organisms is 0.216783.
Ratio of Scraper functional feeding group to total number of organisms is 0.349650.
Ratio of Predator functional feeding group to total number of organisms is 0.034965.
Ratio of Piercer functional feeding group to total number of organisms is 0.013986.

= Clean Water Taxa
= Moderately Tolerant Taxa
D = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
= Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Straight Canyon Creek, Emery County, Manti-Lasal NF, Ferron District DATE: 8 1 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE	MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	S	39	1.596	92	146
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	DRUNELLA	GRANDIS	⊥ S	7	0.856	32	27
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		SO	79	1.897	72	136
INSECTA	PLECOPTERA	CHLOROPERLIDAE			⊥	4	0.555	24	13
INSECTA	PLECOPTERA	NEMOURIDAE			⊥□	11	1.032	36	37
INSECTA	PLECOPTERA	NEMOURIDAE	MALENKA		⊥□S	11	1.032	36	37
INSECTA	PLECOPTERA	PTERONARCYIDAE	PTERONARCELLA	BADIA	⊥□S	4	0.555	30	16
INSECTA	TRICHOPTERA					4	0.555	72	39
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		S	4	0.555	108	59
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		⊥	4	0.555	24	13
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	BRACHYCENTRUS	AMERICANUS	⊥ S	29	1.458	48	69
INSECTA	TRICHOPTERA	HYDROPTILIDAE	HYDROPTILA		S	7	0.856	108	92
INSECTA	TRICHOPTERA	LIMNEPHILIDAE	PSYCHOGLYPHA		⊥□	4	0.555	24	13
INSECTA	COLEOPTERA	ELMIDAE			S	7	0.856	104	89
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA	MONTICOLA	⊥ S	7	0.856	40	34
INSECTA	DIPTERA	SIMULIIDAE			O	79	1.897	108	204
INSECTA	DIPTERA	CHIRONOMIDAE	ORTHOCLADIINAE		SO	194	2.287	108	247
INSECTA	DIPTERA	AHTERICIDAE	ATHERIX		S C	4	0.555	66	36
OLIGOCHAETA	TUBIFICIDAE				SO	18	1.254	108	135

MEAN BIOMASS GM/SQM: 0.3 TOTALS: 513 2.710

TOTAL SAMPLE STATISTICS

STATION: 1 Straight Canyon Creek, at Forest Bndry, Emery County, Manti-Lasal NF DATE: 10 12 95

Repl	Total No. Taxa	Mean /SQM	Confidence Limits (80 Percent) LL	UL	Standard Deviation	Percent SE of Mean	Coeff. of Variation	DBAR	CTQA	CTQD
3	9	47	14	79	29.81	36.90	63.90	2.9312	58	62

EPT Index is 53.85%.
EPT/Chironmidae is 25.12.
The Margalef Index of richness is 2.082.
The Menhinick Index of richness is 1.318.
Simpson's Diversity Index is 0.141.
Hill's Evenness Index is 0.927.
Shannon's Index is 2.032.
The Modified Hilsenhoff Tolerance Index is 1.600.
Percent contribution of dominant taxa is 69.23%.
Ratio of Scrapers to Collector-Gatherers is 0.571429.

Functional feeding groups
Ratio of Shredder functional feeding group to total number of organisms is 0.000000.
Ratio of Coll/Gath functional feeding group to total number of organisms is 0.538462.
Ratio of Filterer functional feeding group to total number of organisms is 0.000000.
Ratio of Scraper functional feeding group to total number of organisms is 0.307692.
Ratio of Predator functional feeding group to total number of organisms is 0.461538.
Ratio of Piercer functional feeding group to total number of organisms is 0.000000.

- = Clean Water Taxa
⊥ = Moderately Tolerant Taxa
D = Shredders
S = Sediment Tolerant Taxa
O = Organic Enrichment Tolerant Taxa
C = Adverse Chemistry Tolerant Taxa
U = Large Stoneflies

SPECIES ANALYSIS

STATION: 1 Straight Canyon Creek, at Forest Bndry, Emery County, Manti-Lasal NF DATE: 10 12 95

TAXONOMIC LIST CLASS	ORDER	FAMILY	GENUS	SPECIES	TYPE	MEAN N/SQM	LOG10 N/SQM	TQ	LOG10 XTQ
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	DRUNELLA	GRANDIS	⊥ S	4	0.555	32	17
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		SO	7	0.856	72	61
INSECTA	PLECOPTERA	PERLODIDAE	ISOGENOIDES		⊥ S	4	0.555	30	16
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA		⊥ S	4	0.555	48	26
INSECTA	PLECOPTERA	PERLIDAE	HESPEROPERLA	PACIFICA	⊥ S U	4	0.555	30	16
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA	COLORADENSIS	⊥	4	0.555	30	16
INSECTA	DIPTERA	AHTERICIDAE	ATHERIX		S C	4	0.555	66	36
GASTROPODA	LYMNAEIDAE	LYMNAEA			O	4	0.555	108	59
OLIGOCHAETA	TUBIFICIDAE				SO	14	1.157	108	124

MEAN BIOMASS GM/SQM: 0.1 TOTALS: 47 1.669

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CYPRUS AMAX MINERALS COMPANY

(formerly Amoco Minerals Company; name changed to Cyprus Minerals Company 5/24/85; name changed to Cyprus Amax Minerals Company pursuant to the merger with Amax Inc. on November 15, 1993)

Principal Operating Office:	9100 East Mineral Circle Englewood, Colorado 80112-3299
Telephone:	303/643-5000
Incorporation:	
State	Delaware
Date	September 2, 1969
Existence	Perpetual
Qualified to Do Business In:	Arizona, Colorado, Delaware
IRS Identification Number:	36-2684040

OFFICERS:

Title	Name	Date Assumed Office
President and Chief Executive Officer	M. H. Ward	May 14, 1992
Senior Vice President and Chief Financial Officer	G. J. Malys	August 1, 1989
Senior Vice President, Coal	G. R. Spindler	January 3, 1995
Senior Vice President, Copper	J. G. Clevenger	January 27, 1993
Senior Vice President, General Counsel and Secretary	P. C. Wolf	March 24, 1991/November 12, 1993/ November 12, 1993
Senior Vice President, Exploration	D. H. Watkins	February 1, 1994
Vice President, Investor Relations, and Treasurer	F. J. Kane	January 11, 1994
Vice President and Controller	J. Taraba	October 31, 1988
Vice President, Engineering and Development	R. J. Hickson	November 20, 1994
Assistant Treasurer	F. S. Hakimi	July 31, 1987
Director of Tax	J. D. Flemming	May 7, 1992
Assistant Secretary	D. E. Huffman	July 31, 1995
DIRECTORS:	M. H. Ward (Chairman)	May 14, 1992/November 15, 1995
	A. Born	November 13, 1993
	L. G. Alvarado	December 14, 1989
	G. S. Ansell	December 3, 1987
	W. C. Bousquette	December 5, 1991
	T. V. Falkie	June 29, 1988
	A. M. Gray	November 15, 1993
	J. C. Huntington, Jr.	November 15, 1993
	M. A. Morphy	July 1, 1985
	R. A. Schnabel	February 11, 1993
	T. M. Solso	November 15, 1993
	J. H. Stookey	November 15, 1993
	J. A. Todd, Jr.	October 22, 1992
	B. B. Turner	October 22, 1992

CYPRUS AMAX MINERALS COMPANY

(formerly Amoco Minerals Company; name changed to Cyprus Minerals Company 5/24/85; name changed to Cyprus Amax Minerals Company pursuant to the merger with Amax Inc. on November 15, 1993)

Resignations (since November 1993):

Title	Name	Date Resigned
Senior Vice President, General Counsel, and Secretary	K. Loughrey	November 12, 1993
Chairman of the Board	M. H. Ward	November 15, 1993
Assistant Secretary	D. J. Friedman	December 31, 1993
Vice President and Treasurer	D. C. Haugh	January 11, 1994
Vice President, Public and Investor Relations	R. H. Hagman	January 11, 1994
Vice President, Exploration	F. B. Park	February 1, 1994
Director	J. J. Kerley	April 29, 1993
Director	V. F. Taylor, Jr.	April 29, 1993
Director	P. C. Walsh	April 29, 1993
Director	C. A. Campbell, Jr.	May 4, 1994
Senior Vice President, Coal	D. P. Brown	December 30, 1994
Vice President, Human Resources	G. H. Peppard	June 30, 1995
Assistant Secretary	K. J. Gormley	July 31, 1995
Co-Chairman of the Board	M. H. Ward	November 15, 1995
Co-Chairman of the Board	A. Born	November 15, 1995
Vice Chairman of the Board	A. Born	May 1, 1996

AMAX ENERGY INC.

Principal Operating Office:	9100 East Mineral Circle Englewood, Colorado 80112-3299
Telephone:	303/643-5000
Incorporation:	
State	Delaware, The Corporation Trust Company, 1209 Orange Street, Wilmington, DE 19801
Date	July 26, 1991
Existence	Perpetual
Qualified to Do Business In:	Delaware, Connecticut, Indiana, Texas
Ownership - Percentage:	Cyprus Amax Minerals Company - 100%; November 15, 1993 9100 East Mineral Circle, Englewood, Colorado 80112-3299
Employer I.D. No.:	06-1324916

OFFICERS:

Title	Name	Social Security #	Date Assumed Office
President	Gerald J. Malys	[redacted]	April 11, 1994
Senior Vice President, General Counsel and Secretary	Philip C. Wolf	[redacted]	November 15, 1993
Vice President and Treasurer	Francis J. Kane	[redacted]	January 11, 1994
Vice President and Controller	John Taraba	[redacted]	November 15, 1993
Director of Tax	J. David Flemming	[redacted]	November 15, 1993
Assistant Secretary	Dale E. Huffman	[redacted]	April 11, 1994
Assistant Secretary	Sharon J. Fetherhuff	[redacted]	July 31, 1995
DIRECTORS:	Gerald J. Malys	[redacted]	November 15, 1993
	Philip C. Wolf	[redacted]	November 15, 1993

AMAX ENERGY INC.

Resignations (since November 1993):

Title	Name	Social Security No.	Date Resigned
Chairman of the Board	Allen Born		November 15, 1993
Senior Vice President	Gary D. McDowell		November 15, 1993
Vice President, Secretary and Director	Helen M. Feeney		November 15, 1993
Vice President	Gary Foster		November 15, 1993
Vice President and Treasurer	Lee A. Nickerson		November 15, 1993
Controller	Richard B. Hallett		November 15, 1993
Assistant Secretary	Michael W. Borkowski		November 15, 1993
Assistant Secretary	Raymond J. Cooke		November 15, 1993
Assistant Secretary	J. Alan Ross		November 15, 1993
Assistant Treasurer	Harold E. Davis		November 15, 1993
Assistant Treasurer	Lawrence B. Frost		November 15, 1993
Assistant Treasurer	Thomas P. Wozniak		November 15, 1993
President	Thomas A. McKeever	[redacted]	April 11, 1994
Senior Vice President	Gerald J. Malys	[redacted]	April 11, 1994
Vice President	William G. Hargett	[redacted]	April 11, 1994
Vice President and Assistant Secretary	Wayne E. Gresham	[redacted]	April 11, 1994
Assistant Secretary	Kathleen J. Gormley	[redacted]	July 31, 1995

CYPRUS AMAX COAL COMPANY

(Formerly Cyprus Coal Company, name changed to Cyprus Amax Coal Company 12/16/93)

Principal Operating Office:	9100 East Mineral Circle Englewood, Colorado 80112-3299
Telephone:	303/643-5000
Incorporation:	
State	Delaware, The Corporation Trust Company, 1209 Orange Street, Wilmington, DE 19801
Date	June 18, 1980
Existence	Perpetual
Qualified to Do Business In:	Delaware, Colorado
Ownership - Percentage:	Amax Energy Inc. - 100%; April 20, 1994 9100 East Mineral Circle, Englewood, Colorado 80112-3299
IRS Identification Number:	36-3081314

OFFICERS:

Title	Name	Social Security #	Date Assumed Office
President	Garold R. Spindler	[redacted]	January 3, 1995
Senior Vice President	Gerald J. Malys	[redacted]	August 1, 1989
Senior Vice President, General Counsel, and Secretary	Philip C. Wolf	[redacted]	November 13, 1993
Senior Vice President, Development	Richard D. Mills	[redacted]	April 3, 1995
Senior Vice President, Sales and Marketing	Nicholas P. Moros	[redacted]	December 20, 1993
Senior Vice President, Eastern Region	John M. DeMichiei	[redacted]	April 1, 1996
Senior Vice President, Midwest Region	Kevin S. Crutchfield	[redacted]	April 1, 1996
Senior Vice President, Western Operations	Randall J. Scott	[redacted]	January 3, 1995
Vice President, International Business Development	Vincent J. Calarco,Jr.	[redacted]	April 3, 1995
Vice President and Treasurer	Francis J. Kane	[redacted]	January 11, 1994
Vice President and Controller	Frank J. Wood	[redacted]	December 20, 1993
Vice President	Chris L. Crowl	[redacted]	December 20, 1993
Assistant Treasurer	Farokh S. Hakimi	[redacted]	July 31, 1987
Director of Tax	J. David Flemming	[redacted]	April 6, 1992
Assistant Secretary	Sharon J. Fetherhuff	[redacted]	July 31, 1995
Assistant Secretary	Greg A. Walker	[redacted]	December 20, 1993
Assistant Secretary	Morris W. Kegley	[redacted]	December 20, 1993
Assistant Secretary	Dale E. Huffman	[redacted]	February 1, 1994
Assistant Secretary	Susan E. Chetlin	[redacted]	April 3, 1995
DIRECTORS:	Garold R. Spindler	[redacted]	January 3, 1995
	Gerald J. Malys	[redacted]	August 1, 1989
	Philip C. Wolf	[redacted]	December 31, 1993

CYPRUS AMAX COAL COMPANY

(Formerly Cyprus Coal Company, name changed to Cyprus Amax Coal Company 12/16/93)

Resignations (since November 1993):

Title	Name	Social Security No.	Date Resigned
Senior Vice President, General Counsel, and Secretary	Kevin Loughrey	[redacted]	November 13, 1993
Senior Vice President, Sales and Marketing	George E. Vajda	[redacted]	December 20, 1993
Vice President, Materials, Maintenance & Technical Resources	W. Mark Hart	[redacted]	December 20, 1993
Vice President, Strategic Planning, and Controller	Joseph Caffarelli,Jr.	[redacted]	December 20, 1993
Vice President, Business Development	John E. Baum	[redacted]	December 20, 1993
Vice President, Associate General Counsel, Assistant Secretary and Director	Deborah J. Friedman	[redacted]	December 31, 1993
Vice President and Treasurer	Dennis C. Haugh	[redacted]	December 31, 1993
President and Director	Donald P. Brown	[redacted]	December 30, 1994
Senior Vice President, Eastern Operations	Donald E. Hudson	[redacted]	January 3, 1995
Senior Vice President, Western Operations	J. Mark Cook	[redacted]	January 3, 1995
Assistant Secretary	Michael R. Peelish	[redacted]	January 3, 1995
Senior Vice President, Development	Donald E. Hudson	[redacted]	April 3, 1995
Assistant Secretary	Kathleen J. Gormley	[redacted]	July 31, 1995
Vice President, Allied Resources	Peter J. Bethell	[redacted]	January 8, 1996
Senior Vice President, Eastern Operations	W. Mark Hart	[redacted]	April 1, 1996
Vice President, Allied Resources (elected 1/8/96)	Charles E. Zabrosky	[redacted]	April 25, 1996

CYPRUS WESTERN COAL COMPANY

(Formerly Cyprus Industrial Minerals Company; name changed effective August 26, 1985.)

Principal Operating Office:	9100 East Mineral Circle Englewood, Colorado 80112-3299
Telephone:	303/643-5000
Incorporation:	
State	Delaware, The Corporation Trust Company, 1209 Orange Street, Wilmington, DE 19801
Date	February 12, 1982
Existence	Perpetual
Qualified to Do Business In:	Colorado, Delaware, Utah
Ownership - Percentage:	Cyprus Amax Coal Holding Company - 100%; January 1, 1996 9100 East Mineral Circle, Englewood, Colorado 80112-3299
IRS Identification Number:	36-3200083

OFFICERS:

Title	Name	Social Security #	Date Assumed Office
President	Randall J. Scott	[redacted]	January 3, 1995
Senior Vice President	Gerald J. Malys	[redacted]	August 1, 1989
Senior Vice President, General Counsel, and Secretary	Philip C. Wolf	[redacted]	November 13, 1993
Senior Vice President, Sales and Marketing	Nicholas P. Moros	[redacted]	December 20, 1993
Vice President and Treasurer	Francis J. Kane	[redacted]	January 11, 1994
Vice President and Controller	Frank J. Wood	[redacted]	December 20, 1993
Vice President and General Manager	Allen P. Childs	[redacted]	March 11, 1996
Vice President and General Manager	Keith H. Sieber	[redacted]	April 6, 1992/December 20, 1993
Vice President, Sales and Marketing	George E. Vajda	[redacted]	December 20, 1993
Vice President and Assistant Secretary	Greg A. Walker	[redacted]	December 20, 1993
Vice President	George L. Raymond	[redacted]	December 20, 1993
Assistant Treasurer	Farokh S. Hakimi	[redacted]	July 31, 1987
Director of Tax	J. David Flemming	[redacted]	April 6, 1992
Assistant Secretary	Sharon J. Fetherhuff	[redacted]	July 31, 1995
Assistant Secretary	Morris W. Kegley	[redacted]	December 20, 1993
Assistant Secretary	Dale E. Huffman	[redacted]	February 1, 1994
Assistant Secretary	Susan E. Chetlin	[redacted]	April 3, 1995

DIRECTORS:			
	Garold R. Spindler	[redacted]	January 3, 1995
	Gerald J. Malys	[redacted]	August 1, 1989
	Philip C. Wolf	[redacted]	December 31, 1993

CYPRUS WESTERN COAL COMPANY

(Formerly Cyprus Industrial Minerals Company; name changed effective August 26, 1985.)

Resignations (since November 1993):

Title	Name	Social Security No.	Date Resigned
President	Donald P. Brown	[redacted]	December 20, 1993
Senior Vice President, General Counsel, and Secretary	Kevin Loughrey	[redacted]	November 13, 1993
Senior Vice President, Operation	Donald E. Hudson	[redacted]	Decenber 20, 1993
Senior Vice President, Sales and Marketing	George E. Vajda	[redacted]	December 20, 1993
Vice President, Business Development, and Controller	Joseph Caffarelli,Jr.	[redacted]	December 20, 1993
Vice President, Associate General Counsel, Assistant Secretary and Director	Deborah J. Friedman	[redacted]	December 31, 1993
Vice President and Treasurer	Dennis C. Haugh	[redacted]	December 31, 1993
President	J. Mark Cook	[redacted]	January 3, 1995
Vice President and General Manager	W. Mark Hart	[redacted]	January 3, 1995
Assistant Secretary	Michael R. Peelish	[redacted]	January 3, 1995
Director	Donald P. Brown	[redacted]	December 30, 1994
Vice President, Labor, Safety and Government Relations	Chris L. Crowl	[redacted]	July 31, 1995
Assistant Secretary	Kathleen J. Gormley	[redacted]	July 31, 1995
Vice President and General Manager	William Ivy	[redacted]	February 15, 1996

CYPRUS PLATEAU MINING CORPORATION

(formerly Plateau Mining Company; name changed effective June 8, 1987)

Mailing Address: P.O. Box Drawer PMC
Price, Utah 84501

Telephone: 801/637-2875

Incorporation:
- State: Delaware, The Corporation Trust Company, 1209 Orange Street, Wilmington, DE 19801
- Date: August 26, 1982
- Existence: Perpetual

Qualified to Do Business In: Delaware, Colorado, Utah

Ownership - Percentage: Cyprus Western Coal Company - 100%; June 5, 1990
9100 East Mineral Circle, Englewood, Colorado 80112-3299

IRS Identification Number: 95-3761213

OFFICERS:

Title	Name	Social Security #	Date Assumed Office
President	Randall J. Scott	[redacted]	January 3, 1995
Senior Vice President	Gerald J. Malys	[redacted]	August 1, 1989
Senior Vice President, General Counsel, and Secretary	Philip C. Wolf	[redacted]	November 13, 1993
Senior Vice President, Sales and Marketing	Nicholas P. Moros	[redacted]	December 20, 1993
Vice President and General Manager	Allen P. Childs	[redacted]	March 11, 1996
Vice President and Treasurer	Francis J. Kane	[redacted]	January 11, 1994
Vice President and Controller	Frank J. Wood	[redacted]	December 20, 1993
Vice President, Sales and Marketing	George E. Vajda	[redacted]	December 20, 1993
Assistant Treasurer	Farokh S. Hakimi	[redacted]	July 31, 1987
Director of Tax	J. David Flemming	[redacted]	April 6, 1992
Assistant Secretary	Sharon J. Fetherhuff	[redacted]	July 31, 1995
Assistant Secretary	Greg A. Walker	[redacted]	December 20, 1993
Assistant Secretary	Morris W. Kegley	[redacted]	December 20, 1993
Assistant Secretary	Dale E. Huffman	[redacted]	February 1, 1994
Assistant Secretary	Susan E. Chetlin	[redacted]	April 3, 1995

DIRECTORS:

Garold R. Spindler	[redacted]	January 3, 1995
Gerald J. Malys	[redacted]	August 1, 1989
Philip C. Wolf	[redacted]	December 31, 1993

CYPRUS PLATEAU MINING CORPORATION
(formerly Plateau Mining Company; name changed effective June 8, 1987)

Resignations (since November 1993):

Title	Name	Social Security No.	Date Resigned
President	Donald P. Brown	[redacted]	December 20, 1993
Senior Vice President, General Counsel, and Secretary	Kevin Loughrey	[redacted]	November 13, 1993
Senior Vice President, Operations	Donald E. Hudson	[redacted]	December 20, 1993
Senior Vice President, Sales and Marketing	George E. Vajda	[redacted]	December 20, 1993
Vice President, Business Development, and Controller	Joseph Caffarelli,Jr.	[redacted]	December 20, 1993
Vice President, Materials, Maintenance & Technical Resources	W. Mark Hart	[redacted]	December 20, 1993
Vice President, Associate General Counsel, Assistant Secretary and Director	Deborah J. Friedman	[redacted]	December 31, 1993
Vice President and Treasurer	Dennis C. Haugh	[redacted]	December 31, 1993
President	J. Mark Cook	[redacted]	January 3, 1995
Assistant Secretary	Michael R. Peelish	[redacted]	January 3, 1995
Director	Donald P. Brown	[redacted]	December 30, 1994
Vice President, Labor, Safety and and Government Relations	Chris L. Crowl	[redacted]	July 31, 1995
Assistant Secretary	Kathleen J. Gormley	[redacted]	July 31, 1995
Vice President and General Manager	Keith H. Sieber	[redacted]	February 15, 1996

CYPRUS AMAX MINERALS COMPANY

Cyprus Amax Minerals Company
9100 East Mineral Circle
Post Office Box 3299
Englewood, Colorado 80155-3299
(303) 643-5000

September 8, 1995

State of Utah
Department of Commerce
P.O. Box 30750
Salt Lake City, UT 84189-0001

Cyprus Plateau Mining Corporation

Dear Sir or Madam:

Enclosed on behalf of the above company is the Profit Corporation Annual Report and/or payment as indicated below:

STATE OF:	UT
TYPE OF RETURN:	Profit Annual Report
PERIOD COVERED:	1995
PAYMENT:	$15.00

Very truly yours,

Sharon Fetherhuff

Sharon J. Fetherhuff

SJF:tlc

Enclosure

Z 847 387 322

STATE OF UTAH
DEPARTMENT OF COMMERCE
DIVISION OF CORPORATIONS AND COMMERCIAL CODE

PROFIT CORPORATION ANNUAL REPORT

The following information is on file in this office. All profit corporations must file their annual reports and corrections within the month of Their anniversary date. Failure to do so will result in Delinquency, Suspension, then Revocation or Involuntary Dissolution of the corporate charter. THIS BOX MUST BE COMPLETED

CORPORATE NAME, REGISTERED AGENT, REGISTERED OFFICE, CITY, STATE & ZIP

CORPORATION # 099984
F 09/13/82

1. CYPRUS PLATEAU MINING CORPORATION
2. C T CORPORATION SYSTEM
3. 50 W BROADWAY 8TH FLOOR
4. SALT LAKE CITY UT 84101-2006

MAKE ALL CORRECTIONS IN THIS COLUMN

(Print New Agent Name) NEW AGENT MUST SIGN ABOVE

NEW REGISTERED STREET ADDRESS REQUIRED

(New City) REGISTERED AGENT MUST BE IN UTAH UTAH (Zip)

WHEN CHANGING THE REGISTERED AGENT THE NEW AGENT MUST SIGN.

5. INCORPORATED IN THE STATE AND UNDER THE LAWS OF DELAWARE

6. ADDRESS OF THE PRINCIPAL OFFICE IN THE HOME STATE.
PO DRAWER PMC
PRICE UT 84501

(Street Address) (State or Country)
(City) (ZIP)

7. BUSINESS PURPOSE: BITUMINUS COAL(UNDERGROUND)

DOMESTIC, PROFIT CORPORATIONS ARE REQUIRED TO LIST A CORPORATE OFFICER.

OFFICERS

8. PRESIDENT ~~JM COOK~~
ADDRESS 9100 E MINERAL CR
CITY, STATE & ZIP ENGLEWOOD CO 80155

9. VICE PRESIDENT K. H. SIEBER
ADDRESS 9100 E MINERAL CR
CITY, STATE & ZIP ENGLEWOOD CO 80155

10. SECRETARY PC WOLF
ADDRESS 9100 E MINERAL CR
CITY, STATE & ZIP ENGLEWOOD CO 80155

11. TREASURER FJ KANE
ADDRESS 9100 E MINERAL CR
CITY, STATE & ZIP ENGLEWOOD CO 80155

8. R. J. Scott
9.
10.
11.

IF YOU HAVE LESS THAN 3 SHAREHOLDERS YOU MAY LIST LESS THAN 3 DIRECTORS. IF YOU HAVE NO DIRECTORS DUE TO SECTION 16-10A-732 YOU MUST STATE SO IN THE BOX BELOW.

DIRECTORS

12. DIRECTOR ~~D.P. BROWN~~
ADDRESS 9100 EMINERAL CIRCLE
CITY, STATE & ZIP ENGLEWOOD CO 80112

13. DIRECTOR G. J. MALYS
ADDRESS 9100 EMINERAL CIRCLE
CITY, STATE & ZIP ENGLEWOOD CO 80112

14. DIRECTOR PC WOLF
ADDRESS 9100 E MINERAL CR
CITY, STATE & ZIP ENGLEWOOD CO 80155

12. G. R. Spindler
13.
14.

Under penalties of perjury and as an authorized officer, I declare that this annual report and, if applicable, the statement change of registered office and/or agent, has been examined by me and is, to the best of my knowledge and belief, true, correct, and complete.

15. BY [signature] MUST BE SIGNED BY A CORPORATE OFFICER

16. Assistant Secretary (Title or Position)

17. 9-8 (Date) 19 95

IF THERE ARE NO CHANGES FROM THE PREVIOUS YEAR, AND YOU HAVE ALL CORPORATE REQUIREMENTS FILLED PERTAINING TO OFFICER AND DIRECTOR INFORMATION YOU MAY DETACH THE COUPON BELOW, AND RETURN IT IN THE ENCLOSED ENVELOPE WITH YOUR PAYMENT. YOU MAY KEEP THE ABOVE REPORT FOR YOUR RECORDS.

MAKE ALL CORRECTIONS ON THE FORM ABOVE. FORM NO823I

DO NOT WRITE ON THE COUPON.

NOTE: PLEASE DO NOT FOLD THIS COUPON.

CORPORATION NUMBER: 099984

CORPORATION NAME: CYPRUS PLATEAU MINING CORPORATION
C T CORPORATION SYSTEM
50 W BROADWAY 8TH FLOOR
SALT LAKE CITY UT 84101

DATE DUE: **09/30/95**
AMOUNT DUE: **$15.00**
IF AFTER DUE DATE: **$25.00**

ƒ507000800067050000000104099984000000000000000015007ƒ

Make check payable to:
State of Utah

For information call:
(801) 530-4849

UTAH DEPARTMENT OF COMMERCE
SALT LAKE CITY, UTAH 84189

CYPRUS PLATEAU MINING CORPORATION
9100 EAST MINERAL CIRCLE
ENGLEWOOD, COLORADO 80112

LIST OF OFFICERS & DIRECTORS

OFFICERS

President	R. J. Scott
Senior Vice President	G. J. Malys
Senior Vice President, Sales & Marketing	N. P. Moros
Senior Vice President, General Counsel and Secretary	P. C. Wolf
Vice President and Treasurer	F. J. Kane
Vice President and General Manager	K. H. Sieber
Vice President, Sales and Marketing	G. E. Vajda
Vice President and Controller	F. J. Wood
Assistant Treasurer	F. S. Hakimi
Director of Tax	J. D. Flemming
Assistant Secretary	S. J. Fetherhuff
Assistant Secretary	M. W. Kegley
Assistant Secretary	G. A. Walker
Assistant Secretary	D. E. Huffman
Assistant Secretary	S. E. Chetlin

DIRECTORS

G. J. Malys
P. C. Wolf
G. R. Spindler