Flambeau Mining Company
Subsidiary of Kennecott Corporation
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| To John Coleman | From L. Lynch |
| Co. | Co. DNR |
| Dept. | Phone # |
| Fax # 262-2500 | Fax # |

**Kennecott**

August 17, 1994

Mr. Larry Lynch
Wisconsin Department of Natural Resources
Bureau of Solid and Hazardous Waste Management
101 South Webster Street, GEF II
P.O. Box 7921
Madison, WI 53707-7921

RECEIVED
AUG 19 1994
BUREAU OF SOLID
HAZARDOUS WASTE MANAGEMENT

Dear Mr. Lynch:

RE: Flambeau Project - Modification to the Mining Permit

Flambeau Mining Company (Flambeau) is submitting this letter requesting two minor modifications to its Mining Permit pertaining to the Flambeau Project (reference Docket No. IH-89-14). These modification requests are presented to the Wisconsin Department of Natural Resources (WDNR) pursuant to Part 2, Condition 3 of Flambeau's Mining Permit. Because these modifications do not increase or decrease the mining site and do not change the intent or implementation of the approved mining or reclamation plans, it is our interpretation that the modifications are not substantial. The two modifications have been previously discussed with you. At the time of the discussions it was understood that you concurred that the modifications were not substantial. A description of the requested modifications follows:

1. **Asbestiform Monitoring Schedule.** The schedule for sampling asbestiform was modified pursuant to the request of the Air Monitoring Section of the Bureau of Air Management, WDNR. As discussed in Part 4, Section 5 of the Mine Permit, asbestiform was to be monitored for one month during a 12-month period. The monitoring was to take place between May 1 and September 30. The Department requested, during the review of the asbestiform monitoring plan, that the schedule for monitoring asbestiform be changed to one eight-hour monitoring period for each month, May through September. This sampling schedule was incorporated into the Revised Mining Permit Quality Assurance/Quality Control Document for Asbestiform Sampling dated February 1993.

2. **Groundwater Quality Standards.** In the fall of 1991 Foth & Van Dyke, on behalf of Flambeau, initially discussed with you the fact that the iron, TDS and manganese standards contained in Condition 9 of Part 1-General Conditions of the project's

January14, 1991 Mining Permit were inadvertently established well below some background levels at the site. A review of the methods used to establish standards for these three parameters indicated that the iron standard was set based on the way that iron data was summarized by Foth & Van Dyke in the project's "Environmental Impact Report" (EIR). The presentation of iron data in the EIR was confusing, and therefore misinterpreted. The TDS standard was established without consideration for background conditions at two of the site's groundwater monitoring wells. Manganese standards were set by averaging background conditions, which did not consider the fact that averages by nature result in some data being below and other data being above the average. Your discussions with Foth & Van Dyke concluded with an understanding that the project's permit needed to be modified to remedy the situation. As we understand, you informed Foth & Van Dyke that the WDNR recognizes and acknowledges that the required permit modification is not a substantive issue.

Subsequent to the initial discussion, you and Foth & Van Dyke also discussed alternative iron, TDS and manganese groundwater standards for the project. As a result of those discussions, it was agreed that, based on WDNR's interpretation of the project's Mining Permit and NR 182, the following applies to the Flambeau project:

- The applicable groundwater standard at the compliance boundary is to be equal to the mean background results, if the mean exceeds a secondary MCL.

- If the baseline for any parameter at any individual monitoring well in the monitoring program exceeded the standard, then the standard for that parameter at that well as relates to the intervention boundary becomes the test for statistical significance. That is, if any result above the standard is deemed to be statistically significant when compared to the historical values for that particular well, the contingency plan provisions of Condition 9 c) of Part 1 of the project's Mining Permit would apply.

Based on the above, Foth & Van Dyke, on behalf of Flambeau, has calculated updated applicable groundwater standards for iron and manganese and alternative concentration limits (ACL's) for iron, manganese and TDS for groundwater monitoring wells for which the baseline for the parameter exceeds existing and the newly proposed standards. The result of these calculations are presented in Tables 1 and 2.

## Table 1

### Proposed Iron and Manganese Groundwater Standards

| Parameter | Standard (mg/L) |
|---|---|
| Iron | Baseline |
| | 4.19 (overburden) |
| | 1.67 (shallow precambrian) |
| | 0.43 (deep precambrian) |
| Manganese | Baseline |
| | 0.18 (overburden) |
| | 0.13 (shallow precambrian) |
| | 0.31 (deep precambrian) |

## Table 2

## Proposed ACLs for Iron, Manganese and TDS

| Monitoring Well | Type[1] | ACL (mg/L) Iron | Manganese | TDS |
|---|---|---|---|---|
| MW-1000R | O.B. | --- | 1.17 | --- |
| MW-1000P | D.P. | 3.8 | 1.04 | --- |
| MW-1002 | O.B. | --- | 0.21 | --- |
| MW-1004 | O.B. | --- | 0.28 | 1,234 |
| MW-1004P | D.P. | 0.60 | --- | --- |
| MW-1005 | O.B. | 27.6 | 1.31 | 1,000 |
| MW-1005S | S.P. | 4.88 | 0.32 | --- |
| MW-1005P | D.P. | 4.17 | --- | --- |

1 O.B. = overburden
S.P. = shallow precambrian
D.P. = deep precambrian

The applicable groundwater standard for application at the compliance boundary was calculated by determining the mean of all groundwater monitoring results for iron, manganese and TDS from October of 1987 through the January 1993 quarterly monitoring round for those monitoring wells currently included in the site monitoring program. The statistical analysis showed no significant variance in the data for the three parameters after 1989. Therefore, to increase the sample population, available data through January 1993 was used in the analysis. Statistical methodologies and calculations pertaining to the establishment of proposed groundwater standards for iron and manganese are contained on Exhibits I and IV, which are appended to this letter.

Mr. Larry Lynch
Bureau of Solid and Hazardous Waste Management
August 17, 1994
Page 5

Alternative concentration limits were calculated by placing upper tolerance limits on site historical data for the period of October 1987 through January of 1993. The ACL will act as the point where monitoring results will require that the provisions of Condition 9 c) of Part 1 of the project's Mining Permit be followed. The use of the ACL will eliminate the need for a statistical analysis each time that the groundwater standard is exceeded at a given monitoring well during any given monitoring round. Calculations and statistical methodologies for ACLs are contained in Exhibits II, III and IV, which are appended to this letter.

Statistical methods used for calculating the proposed iron and manganese groundwater standards and ACLs were chosen based on the need to measure significance at the 95% confidence level as specified in NR 182.075(1)(a) and NR 182.04(46). The statistical methodology used as referenced in Exhibits II and III provides an estimate of the upper limit for the upper 95th percentile of the distribution of background measurements. With this method, any future result which exceeds its respective upper tolerance limit would show that a statistically significant increase has occurred with 95% confidence. Use of the approach involving the "mean plus two standard deviations" will provide confidence levels below 95%, and therefore is not applicable. ??

If you have any questions or comments, please contact us at your convenience.

Sincerely,

Jana E. Murphy

Jana E. Murphy
Supervisor of Environmental Affairs

JM:tlw

cc: Greg Fauquier, Flambeau Mining Company
Henry J. Handzel, DeWitt Porter, *et al.*
Ken Markart, Wisconsin Department of Natural Resources
Bernie Dukerschein, Rusk County Board
Tom Riegel, Town of Grant
Al Christianson, City of Ladysmith
Melvin Spencer, Rusk County Zoning Administrator
Jerry Sevick, Foth & Van Dyke

# Exhibit I

## Data and Calculations for Iron and Manganese Groundwater Standards

Summary Statistics of Iron and Manganese
(Wells Included in Site Monitoring Program)*
(Data Collected Between October 1987 and January 1993)

Flambeau Mining Co.

| | Overburden | Shallow Precambrian | Deep Precambrian |
|---|---|---|---|
| **Iron** | | | |
| Total Samples | 93 | 54 | 80 |
| Total Detections | 39 | 29 | 59 |
| Minimum (mg/l) | <0.055 | <0.055 | <0.055 |
| Maximum (mg/l) | 24.0 | 4.30 | 3.70 |
| Mean** (mg/l) | 4.19 | 1.67 | 0.43 |
| **Manganese** | | | |
| Total Samples | 77 | 38 | 64 |
| Total Detections | 37 | 22 | 63 |
| Minimum (mg/l) | <0.004 | <0.004 | 0.031 |
| Maximum (mg/l) | 1.4 | 0.29 | 0.88 |
| Mean** (mg/l) | 0.18 | 0.13 | 0.31 |

* Includes Overburden Monitoring Wells MW-1000R, 1002, 1002G, 1004, 1005; Shallow Precambrian Wells 1004S and 1005S; Deep Precambrian Wells 1000P, 1004P, 1005P, and 1010P

** If Value was Less Than Detection, Zero was Used to Calculate Mean

Summary Statistics of Iron and Manganese

Flambeau Mining Co.

| Well | Date | Iron mg/l | Manganese mg/l |
|---|---|---|---|
| MW-1000R | 15-Oct-87 | | |
| MW-1000R | 05-Nov-87 | | |
| MW-1000R | 02-Dec-87 | | |
| MW-1000R | 06-Jan-88 | | |
| MW-1000R | 03-Feb-88 | | |
| MW-1000R | 02-Mar-88 | | |
| MW-1000R | 07-Apr-88 | | |
| MW-1000R | 04-May-88 | | |
| MW-1000R | 02-Jun-88 | | |
| MW-1000R | 06-Jul-88 | | |
| MW-1000R | 10-Aug-88 | | |
| MW-1000R | 08-Sep-88 | | |
| MW-1000R | 04-Jan-89 | | |
| MW-1000R | 12-Apr-89 | | |
| MW-1000R | 12-Jul-89 | | |
| MW-1000R | 07-Nov-89 | | |
| MW-1000R | 09-Jan-90 | | |
| MW-1000R | 04-Apr-90 | | |
| MW-1000R | 16-Aug-90 | | |
| MW-1000R | 31-Oct-90 | | |
| MW-1000R | 22-Jan-91 | | |
| MW-1000R | 16-Apr-91 | | |
| MW-1000R | 11-Jul-91 | | |
| MW-1000R | 08-Oct-91 | | |
| MW-1000R | 08-Jan-92 | | |
| MW-1000R | 08-Apr-92 | | |
| MW-1000R | 15-Jul-92 | | |
| MW-1000R | 06-Oct-92 | | |
| MW-1000R | 06-Jan-93 | 0.730 | 0.130 |
| Total Samples | | 1 | 1 |
| Total Detects | | 1 | 1 |
| Minimum | | 0.730 | 0.130 |
| Maximum | | 0.730 | 0.130 |
| Mean* | | 0.730 | 0.130 |

* If Value is Less Than Detection Limit, Zero was Used to Calculate the Mean

\- No Sample



Prepared By: SGL Checked By: JBK

Summary Statistics of Iron and Manganese

Flambeau Mining Co.

| Well | Date | Iron mg/l | Manganese mg/l |
|---|---|---|---|
| MW-1000P | 15-Oct-87 | 0.12 | 0.26 |
| MW-1000P | 05-Nov-87 | 0.15 | 0.46 |
| MW-1000P | 02-Dec-87 | 0.11 | 0.59 |
| MW-1000P | 06-Jan-88 | <0.10 | 0.55 |
| MW-1000P | 03-Feb-88 | <0.10 | 0.61 |
| MW-1000P | 02-Mar-88 | <0.10 | 0.65 |
| MW-1000P | 07-Apr-88 | <0.10 | 0.64 |
| MW-1000P | 04-May-88 | <0.10 | 0.59 |
| MW-1000P | 02-Jun-88 | <0.10 | 0.70 |
| MW-1000P | 06-Jul-88 | 0.20 | 0.72 |
| MW-1000P | 10-Aug-88 | 0.11 | 0.75 |
| MW-1000P | 08-Sep-88 | 0.45 | 0.73 |
| MW-1000P | 04-Jan-89 | | |
| MW-1000P | 12-Apr-89 | | |
| MW-1000P | 12-Jul-89 | | |
| MW-1000P | 07-Nov-89 | | |
| MW-1000P | 09-Jan-90 | | |
| MW-1000P | 04-Apr-90 | | |
| MW-1000P | 16-Aug-90 | | |
| MW-1000P | 31-Oct-90 | | |
| MW-1000P | 22-Jan-91 | | |
| MW-1000P | 16-Apr-91 | | |
| MW-1000P | 11-Jul-91 | 0.650 | 0.650 |
| MW-1000P | 08-Oct-91 | 0.840 | 0.880 |
| MW-1000P | 08-Jan-92 | 1.700 | 0.820 |
| MW-1000P | 08-Apr-92 | 1.300 | 0.830 |
| MW-1000P | 15-Jul-92 | 0.470 | 0.730 |
| MW-1000P | 06-Oct-92 | 0.800 | 0.780 |
| MW-1000P | 06-Jan-93 | 0.150 | 0.710 |
| Total Samples | | 19 | 19 |
| Total Detects | | 13 | 19 |
| Minimum | | <0.10 | 0.26 |
| Maximum | | 1.700 | 0.880 |
| Mean* | | 0.371 | 0.676 |

* If Value is Less Than Detection Limit, Zero was Used to Calculate the Mean

\- No Sample

Prepared By: SGL Checked By: JBK

Summary Statistics of Iron and Manganese

Flambeau Mining Co.

| Well | Date | Iron mg/l | Manganese mg/l |
|---|---|---|---|
| MW-1002 | 15-Oct-87 | <0.10 | 0.20 |
| MW-1002 | 05-Nov-87 | <0.10 | 0.21 |
| MW-1002 | 02-Dec-87 | <0.10 | 0.15 |
| MW-1002 | 06-Jan-88 | <0.10 | <0.05 |
| MW-1002 | 03-Feb-88 | <0.10 | <0.05 |
| MW-1002 | 02-Mar-88 | <0.10 | <0.05 |
| MW-1002 | 07-Apr-88 | <0.10 | <0.05 |
| MW-1002 | 04-May-88 | <0.10 | <0.05 |
| MW-1002 | 02-Jun-88 | <0.10 | <0.05 |
| MW-1002 | 06-Jul-88 | <0.10 | <0.05 |
| MW-1002 | 10-Aug-88 | <0.06 | <0.05 |
| MW-1002 | 08-Sep-88 | <0.10 | <0.05 |
| MW-1002 | 04-Jan-89 | | |
| MW-1002 | 12-Apr-89 | | |
| MW-1002 | 12-Jul-89 | | |
| MW-1002 | 07-Nov-89 | | |
| MW-1002 | 09-Jan-90 | | |
| MW-1002 | 04-Apr-90 | | |
| MW-1002 | 16-Aug-90 | | |
| MW-1002 | 31-Oct-90 | | |
| MW-1002 | 22-Jan-91 | | |
| MW-1002 | 16-Apr-91 | | |
| MW-1002 | 11-Jul-91 | 0.990 | 0.005 |
| MW-1002 | 08-Oct-91 | <0.055 | <0.004 |
| MW-1002 | 08-Jan-92 | <0.055 | <0.004 |
| MW-1002 | 08-Apr-92 | <0.055 | <0.004 |
| MW-1002 | 15-Jul-92 | <0.055 | <0.004 |
| MW-1002 | 06-Oct-92 | <0.055 | 0.015 |
| MW-1002 | 06-Jan-93 | 0.059 | 0.005 |
| Total Samples | | 19 | 19 |
| Total Detects | | 2 | 6 |
| Minimum | | <0.055 | <0.004 |
| Maximum | | 0.990 | 0.210 |
| Mean* | | 0.055 | 0.031 |

* If Value is Less Than Detection Limit, Zero was Used to Calculate the Mean

\- No Sample

Prepared By: SGL Checked By: JBK

Summary Statistics of Iron and Manganese

Flambeau Mining Co.

| Well | Date | Iron mg/l | Manganese mg/l |
|---|---|---|---|
| MW-1002G | 15-Oct-87 | <0.10 | 0.09 |
| MW-1002G | 05-Nov-87 | <0.10 | 0.12 |
| MW-1002G | 02-Dec-87 | <0.10 | 0.09 |
| MW-1002G | 06-Jan-88 | <0.10 | <0.05 |
| MW-1002G | 03-Feb-88 | <0.10 | <0.05 |
| MW-1002G | 02-Mar-88 | <0.10 | <0.05 |
| MW-1002G | 07-Apr-88 | <0.10 | <0.05 |
| MW-1002G | 04-May-88 | <0.10 | <0.05 |
| MW-1002G | 02-Jun-88 | <0.10 | <0.05 |
| MW-1002G | 06-Jul-88 | <0.10 | <0.05 |
| MW-1002G | 10-Aug-88 | <0.06 | <0.05 |
| MW-1002G | 08-Sep-88 | <0.10 | <0.05 |
| MW-1002G | 04-Jan-89 | | |
| MW-1002G | 12-Apr-89 | | |
| MW-1002G | 12-Jul-89 | | |
| MW-1002G | 07-Nov-89 | | |
| MW-1002G | 09-Jan-90 | | |
| MW-1002G | 04-Apr-90 | | |
| MW-1002G | 16-Aug-90 | | |
| MW-1002G | 31-Oct-90 | | |
| MW-1002G | 22-Jan-91 | | |
| MW-1002G | 16-Apr-91 | | |
| MW-1002G | 11-Jul-91 | <0.055 | 0.005 |
| MW-1002G | 08-Oct-91 | <0.055 | <0.004 |
| MW-1002G | 08-Jan-92 | <0.055 | <0.004 |
| MW-1002G | 08-Apr-92 | <0.055 | <0.004 |
| MW-1002G | 15-Jul-92 | <0.055 | <0.004 |
| MW-1002G | 06-Oct-92 | <0.055 | <0.004 |
| MW-1002G | 06-Jan-93 | <0.055 | <0.004 |
| Total Samples | | 19 | 19 |
| Total Detects | | 0 | 4 |
| Minimum | | <0.055 | <0.004 |
| Maximum | | <0.10 | 0.120 |
| Mean* | | 0 | 0.016 |

* If Value is Less Than Detection Limit, Zero was Used to Calculate the Mean

- No Sample

Prepared By: SGL Checked By: JBK

Summary Statistics of Iron and Manganese

Flambeau Mining Co.

| Well | Date | Iron mg/l | Manganese mg/l |
|---|---|---|---|
| MW-1004 | 15-Oct-87 | 0.21 | <0.05 |
| MW-1004 | 05-Nov-87 | 0.26 | 0.28 |
| MW-1004 | 02-Dec-87 | 0.12 | 0.07 |
| MW-1004 | 06-Jan-88 | <0.10 | <0.05 |
| MW-1004 | 03-Feb-88 | <0.10 | 0.05 |
| MW-1004 | 02-Mar-88 | <0.10 | <0.05 |
| MW-1004 | 07-Apr-88 | <0.10 | <0.05 |
| MW-1004 | 04-May-88 | <0.10 | <0.05 |
| MW-1004 | 02-Jun-88 | <0.10 | <0.05 |
| MW-1004 | 06-Jul-88 | 0.12 | <0.05 |
| MW-1004 | 10-Aug-88 | <0.06 | <0.05 |
| MW-1004 | 08-Sep-88 | <0.10 | 0.06 |
| MW-1004 | 04-Jan-89 | | |
| MW-1004 | 12-Apr-89 | <0.055 | |
| MW-1004 | 12-Jul-89 | 0.097 | |
| MW-1004 | 07-Nov-89 | 0.055 | |
| MW-1004 | 09-Jan-90 | <0.026 | |
| MW-1004 | 04-Apr-90 | 0.077 | |
| MW-1004 | 16-Aug-90 | <0.055 | |
| MW-1004 | 31-Oct-90 | <0.055 | |
| MW-1004 | 22-Jan-91 | | |
| MW-1004 | 16-Apr-91 | 0.110 | |
| MW-1004 | 11-Jul-91 | <0.055 | 0.004 |
| MW-1004 | 08-Oct-91 | <0.055 | <0.004 |
| MW-1004 | 08-Jan-92 | <0.055 | <0.004 |
| MW-1004 | 08-Apr-92 | <0.055 | <0.004 |
| MW-1004 | 15-Jul-92 | 0.059 | 0.057 |
| MW-1004 | 06-Oct-92 | <0.055 | <0.004 |
| MW-1004 | 06-Jan-93 | <0.055 | <0.004 |
| Total Samples | | 27 | 19 |
| Total Detects | | 9 | 6 |
| Minimum | | <0.026 | <0.004 |
| Maximum | | 0.260 | 0.280 |
| Mean* | | 0.041 | 0.027 |

* If Value is Less Than Detection Limit, Zero was Used to Calculate the Mean

\- No Sample



Prepared By: SGL Checked By: JBK

Summary Statistics of Iron and Manganese

Flambeau Mining Co.

| Well | Date | Iron mg/l | Manganese mg/l |
|---|---|---|---|
| MW-1004S | 15-Oct-87 | 0.11 | 0.11 |
| MW-1004S | 05-Nov-87 | <0.10 | 0.09 |
| MW-1004S | 02-Dec-87 | <0.10 | 0.07 |
| MW-1004S | 06-Jan-88 | <0.10 | <0.05 |
| MW-1004S | 03-Feb-88 | <0.10 | <0.05 |
| MW-1004S | 02-Mar-88 | <0.10 | <0.05 |
| MW-1004S | 07-Apr-88 | <0.10 | <0.05 |
| MW-1004S | 04-May-88 | <0.10 | <0.05 |
| MW-1004S | 02-Jun-88 | <0.10 | <0.05 |
| MW-1004S | 06-Jul-88 | <0.10 | <0.05 |
| MW-1004S | 10-Aug-88 | <0.06 | <0.05 |
| MW-1004S | 08-Sep-88 | <0.10 | <0.05 |
| MW-1004S | 04-Jan-89 | | |
| MW-1004S | 12-Apr-89 | <0.055 | |
| MW-1004S | 12-Jul-89 | <0.055 | |
| MW-1004S | 07-Nov-89 | <0.023 | |
| MW-1004S | 09-Jan-90 | <0.026 | |
| MW-1004S | 04-Apr-90 | <0.055 | |
| MW-1004S | 16-Aug-90 | <0.055 | |
| MW-1004S | 31-Oct-90 | 0.660 | |
| MW-1004S | 22-Jan-91 | | |
| MW-1004S | 16-Apr-91 | <0.055 | |
| MW-1004S | 11-Jul-91 | <0.055 | <0.004 |
| MW-1004S | 08-Oct-91 | <0.055 | <0.004 |
| MW-1004S | 08-Jan-92 | <0.055 | <0.004 |
| MW-1004S | 08-Apr-92 | <0.055 | <0.004 |
| MW-1004S | 15-Jul-92 | <0.055 | <0.004 |
| MW-1004S | 06-Oct-92 | <0.055 | <0.004 |
| MW-1004S | 06-Jan-93 | <0.055 | <0.004 |
| Total Samples | | 27 | 19 |
| Total Detects | | 2 | 3 |
| Minimum | | <0.023 | <0.004 |
| Maximum | | 0.660 | 0.110 |
| Mean* | | 0.029 | 0.014 |

* If Value is Less Than Detection Limit, Zero was Used to Calculate the Mean

\- No Sample



Prepared By: SGL Checked By: JBK

Summary Statistics of Iron and Manganese

Flambeau Mining Co.

| Well | Date | Iron mg/l | Manganese mg/l |
|---|---|---|---|
| MW-1004P | 15-Oct-87 | <0.10 | 0.12 |
| MW-1004P | 05-Nov-87 | <0.10 | 0.13 |
| MW-1004P | 02-Dec-87 | <0.10 | 0.14 |
| MW-1004P | 06-Jan-88 | 0.10 | 0.14 |
| MW-1004P | 03-Feb-88 | 0.55 | 0.21 |
| MW-1004P | 02-Mar-88 | <0.10 | <0.12 |
| MW-1004P | 07-Apr-88 | 0.14 | 0.14 |
| MW-1004P | 04-May-88 | <0.10 | 0.13 |
| MW-1004P | 02-Jun-88 | <0.10 | 0.12 |
| MW-1004P | 06-Jul-88 | 0.19 | 0.13 |
| MW-1004P | 10-Aug-88 | <0.06 | 0.12 |
| MW-1004P | 08-Sep-88 | <0.10 | 0.11 |
| MW-1004P | 04-Jan-89 | | |
| MW-1004P | 12-Apr-89 | 0.260 | |
| MW-1004P | 12-Jul-89 | 0.630 | |
| MW-1004P | 07-Nov-89 | 0.250 | |
| MW-1004P | 09-Jan-90 | 0.330 | |
| MW-1004P | 04-Apr-90 | 0.200 | |
| MW-1004P | 16-Aug-90 | 0.310 | |
| MW-1004P | 31-Oct-90 | 0.220 | |
| MW-1004P | 22-Jan-91 | | |
| MW-1004P | 16-Apr-91 | 0.320 | |
| MW-1004P | 11-Jul-91 | 0.330 | 0.130 |
| MW-1004P | 08-Oct-91 | 0.220 | 0.130 |
| MW-1004P | 08-Jan-92 | 0.320 | 0.120 |
| MW-1004P | 08-Apr-92 | 0.370 | 0.140 |
| MW-1004P | 15-Jul-92 | 0.380 | 0.130 |
| MW-1004P | 06-Oct-92 | 0.320 | 0.130 |
| MW-1004P | 06-Jan-93 | 0.390 | 0.140 |
| Total Samples | | 27 | 19 |
| Total Detects | | 19 | 18 |
| Minimum | | <0.06 | <0.12 |
| Maximum | | 0.630 | 0.210 |
| Mean* | | 0.216 | 0.127 |

* If Value is Less Than Detection Limit, Zero was Used to Calculate the Mean

- No Sample



Prepared By: SGL Checked By: JBK

Summary Statistics of Iron and Manganese

Flambeau Mining Co.

| Well | Date | Iron mg/l | Manganese mg/l |
|---|---|---|---|
| MW-1005 | 15-Oct-87 | 7.2 | 1.40 |
| MW-1005 | 05-Nov-87 | 6.1 | 1.10 |
| MW-1005 | 02-Dec-87 | 13.0 | 0.75 |
| MW-1005 | 06-Jan-88 | 12.0 | 0.65 |
| MW-1005 | 03-Feb-88 | 12.0 | 0.75 |
| MW-1005 | 02-Mar-88 | 7.9 | 0.71 |
| MW-1005 | 07-Apr-88 | 3.5 | 0.63 |
| MW-1005 | 04-May-88 | 15.0 | 0.56 |
| MW-1005 | 02-Jun-88 | 21.0 | 0.62 |
| MW-1005 | 06-Jul-88 | 19.0 | 0.64 |
| MW-1005 | 10-Aug-88 | 1.1 | 0.45 |
| MW-1005 | 08-Sep-88 | 12.0 | 0.56 |
| MW-1005 | 04-Jan-89 | | |
| MW-1005 | 12-Apr-89 | 12.0 | |
| MW-1005 | 12-Jul-89 | 7.8 | |
| MW-1005 | 07-Nov-89 | 18.0 | |
| MW-1005 | 09-Jan-90 | 20.0 | |
| MW-1005 | 04-Apr-90 | 16.0 | |
| MW-1005 | 16-Aug-90 | 17.0 | |
| MW-1005 | 31-Oct-90 | 14.0 | |
| MW-1005 | 22-Jan-91 | | |
| MW-1005 | 16-Apr-91 | 15.0 | |
| MW-1005 | 11-Jul-91 | 17.0 | 0.510 |
| MW-1005 | 08-Oct-91 | 20.0 | 0.490 |
| MW-1005 | 08-Jan-92 | 18.0 | 0.460 |
| MW-1005 | 08-Apr-92 | 17.0 | 0.380 |
| MW-1005 | 15-Jul-92 | 19.0 | 0.440 |
| MW-1005 | 06-Oct-92 | 22.0 | 0.470 |
| MW-1005 | 06-Jan-93 | 24.0 | 0.520 |
| Total Samples | | 27 | 19 |
| Total Detects | | 27 | 19 |
| Minimum | | 1.1 | 0.380 |
| Maximum | | 24.0 | 1.40 |
| Mean* | | 14.319 | 0.636 |

* If Value is Less Than Detection Limit, Zero was Used to Calculate the Mean

\- No Sample



Prepared By: SGL Checked By: JBK

Summary Statistics of Iron and Manganese

Flambeau Mining Co.

| Well | Date | Iron mg/l | Manganese mg/l |
|---|---|---|---|
| MW-1005S | 15-Oct-87 | 4.00 | 0.23 |
| MW-1005S | 05-Nov-87 | 3.10 | 0.28 |
| MW-1005S | 02-Dec-87 | 4.00 | 0.29 |
| MW-1005S | 06-Jan-88 | 3.00 | 0.25 |
| MW-1005S | 03-Feb-88 | 3.10 | 0.29 |
| MW-1005S | 02-Mar-88 | 2.60 | 0.26 |
| MW-1005S | 07-Apr-88 | 4.30 | 0.26 |
| MW-1005S | 04-May-88 | 2.10 | 0.28 |
| MW-1005S | 02-Jun-88 | 1.90 | 0.26 |
| MW-1005S | 06-Jul-88 | 4.00 | 0.24 |
| MW-1005S | 10-Aug-88 | 3.40 | 0.27 |
| MW-1005S | 08-Sep-88 | 3.10 | 0.27 |
| MW-1005S | 04-Jan-89 | | |
| MW-1005S | 12-Apr-89 | 3.20 | |
| MW-1005S | 12-Jul-89 | 3.80 | |
| MW-1005S | 07-Nov-89 | 3.30 | |
| MW-1005S | 09-Jan-90 | 3.40 | |
| MW-1005S | 04-Apr-90 | 2.90 | |
| MW-1005S | 16-Aug-90 | 1.70 | |
| MW-1005S | 31-Oct-90 | 2.90 | |
| MW-1005S | 22-Jan-91 | | |
| MW-1005S | 16-Apr-91 | 3.60 | |
| MW-1005S | 11-Jul-91 | 3.00 | 0.210 |
| MW-1005S | 08-Oct-91 | 3.80 | 0.220 |
| MW-1005S | 08-Jan-92 | 3.60 | 0.210 |
| MW-1005S | 08-Apr-92 | 3.70 | 0.200 |
| MW-1005S | 15-Jul-92 | 4.10 | 0.210 |
| MW-1005S | 06-Oct-92 | 3.90 | 0.200 |
| MW-1005S | 06-Jan-93 | 4.10 | 0.210 |
| Total Samples | | 27 | 19 |
| Total Detects | | 27 | 19 |
| Minimum | | 1.700 | 0.200 |
| Maximum | | 4.300 | 0.290 |
| Mean* | | 3.319 | 0.244 |

* If Value is Less Than Detection Limit, Zero was Used to Calculate the Mean

- No Sample



Prepared By: SGL Checked By: JBK

Summary Statistics of Iron and Manganese

Flambeau Mining Co.

| Well | Date | Iron mg/l | Manganese mg/l |
|---|---|---|---|
| MW-1005P | 15-Oct-87 | 0.38 | 0.15 |
| MW-1005P | 05-Nov-87 | 0.56 | 0.24 |
| MW-1005P | 02-Dec-87 | 0.18 | 0.13 |
| MW-1005P | 06-Jan-88 | 0.20 | 0.25 |
| MW-1005P | 03-Feb-88 | 0.22 | 0.25 |
| MW-1005P | 02-Mar-88 | 0.29 | 0.20 |
| MW-1005P | 07-Apr-88 | 0.54 | 0.25 |
| MW-1005P | 04-May-88 | 0.72 | 0.26 |
| MW-1005P | 02-Jun-88 | 0.27 | 0.22 |
| MW-1005P | 06-Jul-88 | 0.63 | 0.25 |
| MW-1005P | 10-Aug-88 | 0.95 | 0.18 |
| MW-1005P | 08-Sep-88 | <0.10 | 0.15 |
| MW-1005P | 04-Jan-89 | | |
| MW-1005P | 12-Apr-89 | 0.26 | |
| MW-1005P | 12-Jul-89 | 1.10 | |
| MW-1005P | 07-Nov-89 | 1.00 | |
| MW-1005P | 09-Jan-90 | 0.98 | |
| MW-1005P | 04-Apr-90 | 0.70 | |
| MW-1005P | 16-Aug-90 | 3.70 | |
| MW-1005P | 31-Oct-90 | 0.89 | |
| MW-1005P | 22-Jan-91 | | |
| MW-1005P | 16-Apr-91 | 0.77 | |
| MW-1005P | 11-Jul-91 | 1.20 | 0.220 |
| MW-1005P | 08-Oct-91 | 1.00 | 0.150 |
| MW-1005P | 08-Jan-92 | 0.75 | 0.160 |
| MW-1005P | 08-Apr-92 | 1.00 | 0.130 |
| MW-1005P | 15-Jul-92 | 0.95 | 0.150 |
| MW-1005P | 06-Oct-92 | 1.20 | 0.100 |
| MW-1005P | 06-Jan-93 | 1.10 | 0.110 |
| Total Samples | | 27 | 19 |
| Total Detects | | 26 | 19 |
| Minimum | | <0.10 | 0.100 |
| Maximum | | 3.700 | 0.260 |
| Mean* | | 0.798 | 0.187 |

* If Value is Less Than Detection Limit, Zero was Used to Calculate the Mean

\- No Sample



Prepared By: SGL Checked By: JBK

Summary Statistics of Iron and Manganese

Flambeau Mining Co.

| Well | Date | Iron mg/l | Manganese mg/l |
|---|---|---|---|
| MW-1010P | 15-Oct-87 | | |
| MW-1010P | 05-Nov-87 | | |
| MW-1010P | 02-Dec-87 | | |
| MW-1010P | 06-Jan-88 | | |
| MW-1010P | 03-Feb-88 | | |
| MW-1010P | 02-Mar-88 | | |
| MW-1010P | 07-Apr-88 | | |
| MW-1010P | 04-May-88 | | |
| MW-1010P | 02-Jun-88 | | |
| MW-1010P | 06-Jul-88 | | |
| MW-1010P | 10-Aug-88 | | |
| MW-1010P | 08-Sep-88 | | |
| MW-1010P | 04-Jan-89 | | |
| MW-1010P | 12-Apr-89 | | |
| MW-1010P | 12-Jul-89 | | |
| MW-1010P | 07-Nov-89 | | |
| MW-1010P | 09-Jan-90 | | |
| MW-1010P | 04-Apr-90 | | |
| MW-1010P | 16-Aug-90 | | |
| MW-1010P | 31-Oct-90 | | |
| MW-1010P | 22-Jan-91 | | |
| MW-1010P | 16-Apr-91 | | |
| MW-1010P | 11-Jul-91 | <0.055 | 0.260 |
| MW-1010P | 08-Oct-91 | <0.055 | 0.280 |
| MW-1010P | 08-Jan-92 | 0.150 | 0.250 |
| MW-1010P | 08-Apr-92 | <0.055 | 0.200 |
| MW-1010P | 15-Jul-92 | <0.055 | 0.086 |
| MW-1010P | 06-Oct-92 | <0.055 | 0.140 |
| MW-1010P | 06-Jan-93 | <0.055 | 0.031 |
| Total Samples | | 7 | 7 |
| Total Detects | | 1 | 7 |
| Minimum | | <0.055 | 0.031 |
| Maximum | | 0.150 | 0.280 |
| Mean* | | 0.021 | 0.178 |

* If Value is Less Than Detection Limit, Zero was Used to Calculate the Mean

\- No Sample



Prepared By: SGL Checked By: JBK

## Exhibit II

## Data and Calculations for Alternative Concentration Limits for Iron, Manganese and TDS

**(Note: See Exhibit III for data and calculation for alternative concentration limits for MW-1000R)**

# Exhibit II

## Data and Calculations for Alternative Concentration Limits for Iron, Manganese and TDS

(Note: See Exhibit III for data and calculation for alternative concentration limits for MW-1000R)

# Foth & Van Dyke
# Memorandum

June 2, 1993

TO: Jerry Sevick

FR: Steve Lehrke *SL*

RE: Computation of Alternative Concentration Limits for Flambeau Mining Company Groundwater Monitoring Wells

## Introduction

Groundwater quality data for several parameters, including iron, manganese and TDS, have been collected by the Flambeau Mining Company since October of 1987. Such sampling occurred monthly from October of 1987 through September of 1988. Quarterly samples were collected and analyzed for selected parameters from April of 1989 through April of 1991. Following commencement of surface facility construction in July 1991, iron, manganese and TDS samples, also among others, have been collected quarterly.

A review of the analytical data for iron, manganese and TDS in comparison to groundwater standards as contained in the project's January 14, 1991, mining permit indicates that concentrations of these parameters are in some cases above the standard. Since the data was collected before actual ore removal at the site, the analytical results represent background conditions. Given this fact, it is necessary to establish alternative concentration limits (ACLs) for the parameters. The appropriate methodology, based on statistical analysis, for establishing ACLs is the topic of this memorandum.

Listed below are the site groundwater monitoring wells for which ACLs were calculated.

| Monitoring Well | Parameters |
|---|---|
| MW-1000R* | Iron, Manganese |
| MW-1000P | Iron, Manganese |
| MW-1002 | Manganese |
| MW-1004 | Manganese, TDS |
| MW-1004P | Iron |
| MW-1005 | Iron, Manganese, TDS |
| MW-1005S | Iron, Manganese |
| MW-1005P | Iron |

* MW-1000R was installed in November of 1992 as a replacement for MW-1000. Baseline data collection (monthly sampling) is currently underway for MW-1000R. Included in Attachment 1 are the past data for MW-1000 and available data for MW-1000R. Based on a review of the data, it can be seen that sample results from MW-1000R are not comparable to the distribution of values collected for MW-1000. Therefore, at the completion of MW-1000R baseline data collection, the appropriate ACLs for this well will be calculated. Data and calculations will be forwarded to WDNR for review and acceptance at this time.

### Statistical Methods

ACLs were calculated for specific groundwater monitoring wells for iron, manganese and TDS by placing upper tolerance limits on the historical data collected from October of 1987 through January of 1993. Historical data from October of 1987 through January of 1993 was used for the analysis to provide as large a data base as possible without adversely affecting the results. An argument can be raised that the data base used for this analysis should only involve data collected prior to the July 1991 commencement of site construction activities. A second argument could be raised that the analysis could involve all data collected prior to the actual commencement (May 1993) of ore removal. To determine what data could reasonably be used for the statistical analysis addressed in this memorandum, an independent analysis was completed to determine if groundwater concentrations observed before surface facility construction commenced at the mine site in July of 1991 differed significantly from those subsequently observed. The conclusion of that analysis is that no significant difference exists in groundwater quality data for iron, manganese and TDS when comparing data collected after 1989. Therefore, since variation observed in the groundwater concentrations are not the result of site construction activities, it is desirable to use all of the historical data thus providing as large a data base as possible.

Calculation of an upper tolerance limit is a procedure which estimates the true 95th percentile of a data set. The 95th percentile was used since values which fall above this point would most likely not be caused by random variation in parameter concentrations. The procedure of calculating upper tolerance limits is given in "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities - Interim Final Guidance" (EPA, 1989), and also in "Statistical Methods for Environmental Pollution Monitoring" (Gilbert, 1987).

The 95th percentile of a distribution is defined as the point at which 95 percent of all values fall below and five percent of all values fall above. A tolerance limit places a confidence interval around this percentile, giving the lowest and highest points between which the 95th percentile could fall. The upper tolerance limit, calculated with a given level of confidence, is therefore the highest probable value for the true 95th percentile.

The method used to calculate the upper tolerance limit is dependant on the distributional shape of the data. If the data are either normally or log-normally distributed, the tolerance limit can be found based on these distributions. If no distributional shape can be found for the data, nonparametric methods must be used. An example of tolerance limits for normally distributed data is given in Figure 1. An example of tolerance limits for log-normally distributed data is given in Figure 2. Figure 3 gives an example of tolerance limits of data with no distributional shape. The calculated upper tolerance limits, along with the original data and summary statistics for the monitoring wells referenced above are presented in Attachment 2. Graphs of the data and the upper tolerance limits represented as alternate concentration limits are presented in Attachment 3.

The method for calculating tolerance limits for normally and log-normally distributed data can be found in EPA (1989) and Gilbert (1987). Under this method, the upper tolerance limit is calculated as:

$\bar{x} + k\,s$

where

$\bar{x}$ = sample mean

k = tolerance factor (Attachment 4)

s = sample standard deviation

The tolerance factors for normally distributed data in Attachment 4 give the highest point at which the 95th percentile will fall with 95 percent confidence. If the data are log-normally distributed, the logarithms for the data are used to find the upper tolerance limit. The exponential function is then used to convert the upper tolerance limit back to the original scale.

The non-parametric method for calculating tolerance limits is given in "Practical Nonparametric Statistics", (Conover, 1980). If the sample size is less than or equal to 20, the procedure is as follows:

1. Order the data from lowest to highest
2. From the cumulative binomial distribution function find the entry under p = .95 closest to 0.95. The cumulative binomial distribution function for sample sizes of 19 and 20 is given in Attachment 5.
3. Use the corresponding number in column y near the left hand column as one less than the position of the upper tolerance limit. This gives the highest value for the 95th percentile with 95 percent confidence.

If the sample size is greater than 20, compute $r - 1 = np + w\sqrt{np\,(1-p)}$

where

r = position of upper tolerance limit

n = sample size

p = percentile being estimated (0.95)

w = confidence level of tolerance limit (95%)

The upper tolerance limit is then found from the value in the $r^{th}$ position in the ordered data. Again, this is the highest point the 95th percentile will fall with 95 percent confidence.

As stated, the method used to calculate the upper tolerance limit is dependant on the distributional shape of the data. Therefore, the distributional assumptions were tested before calculating the tolerance limits. First, the data was tested to determine if it was normally distributed. If the test determined the data was not normally distributed, the logarithms of the data were tested. This determined if the data was log-normally distributed. The appropriate method to calculate the upper tolerance limit was then chosen based on the results of these tests.

The test used to determine if the data were either normally or log-normally distributed was the Kolmogorov-Smirnov goodness of the fit test with Lilliefors modification for normality. This test is given in Conover (1980), and also can be performed in several statistical software packages, including Systat (1990). The results of the tests are presented in Attachment 6. The test was performed on both the original and log-transformed data. If the two-tail probability was above 0.05, it was concluded that the data were either normally or log-normally distributed, respectively. If the probability fell below 0.05 for both tests, nonparametric methods were used.

If the sample values fell below the detection limit, one-half the detection limit was used. It was necessary to use this value rather than zero for the log-transformed data since the logarithm of zero is undefined. One half the detection limit was then used for all sample values below the detection limit in this analysis for consistency. The use of one half the detection limit has no significant effect on the results of the analysis.

## Results

As mentioned, Attachment 2 contains tables depicting monitoring well data for those parameters for which an ACL is proposed. The tables summarize total samples in the sample population, number of detects, and the calculated upper tolerance limit (e.g. proposed alternative concentration limit). Attachment 3 contains graphs that depict the data contained in Attachment 2 and illustrates the relationship between the data and the proposed ACL.

As can be seen from the graphs in Attachment 3, data sets for which the ACL was calculated by non-parametric methods are typically characterized by a few detects and a larger number of non-detected values. In these cases, the lack of variation in the large number of non-detected values is what necessitated the use of non-parametric methods in the calculation of the ACLs. Since there is no consistency in the occurrence of the few detects with respect to individual sampling events and since no valid reason exists to eliminate the detected values from the data set, the detected values must be included when calculating the ACL.

As depicted on graphs for MW-1004P (iron) and MW-1005 (manganese), a single past data point actually falls above the proposed ACL. Given the number of data points in the historical data base, it is not unexpected for a small number of points to lie above the ACL.

## References

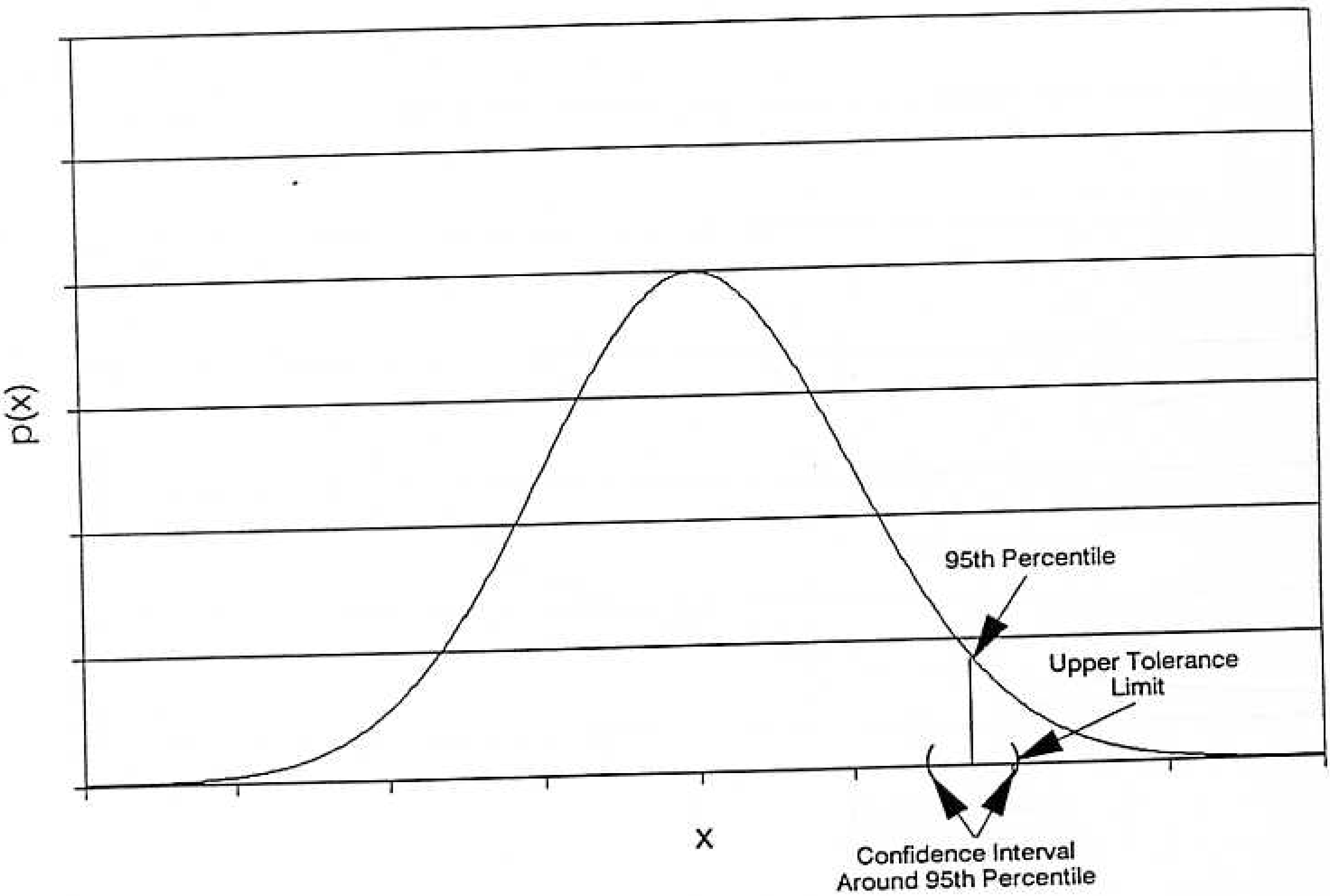

Conover, W.J. (1980) Practical Nonparametric Statistics, Second Edition, John Wiley & Sons, New York.

Gilbert, R.O. (1987) Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York.

Systat, Inc. (1990) Systat: The System for Statistics, Evanston, Illinois.

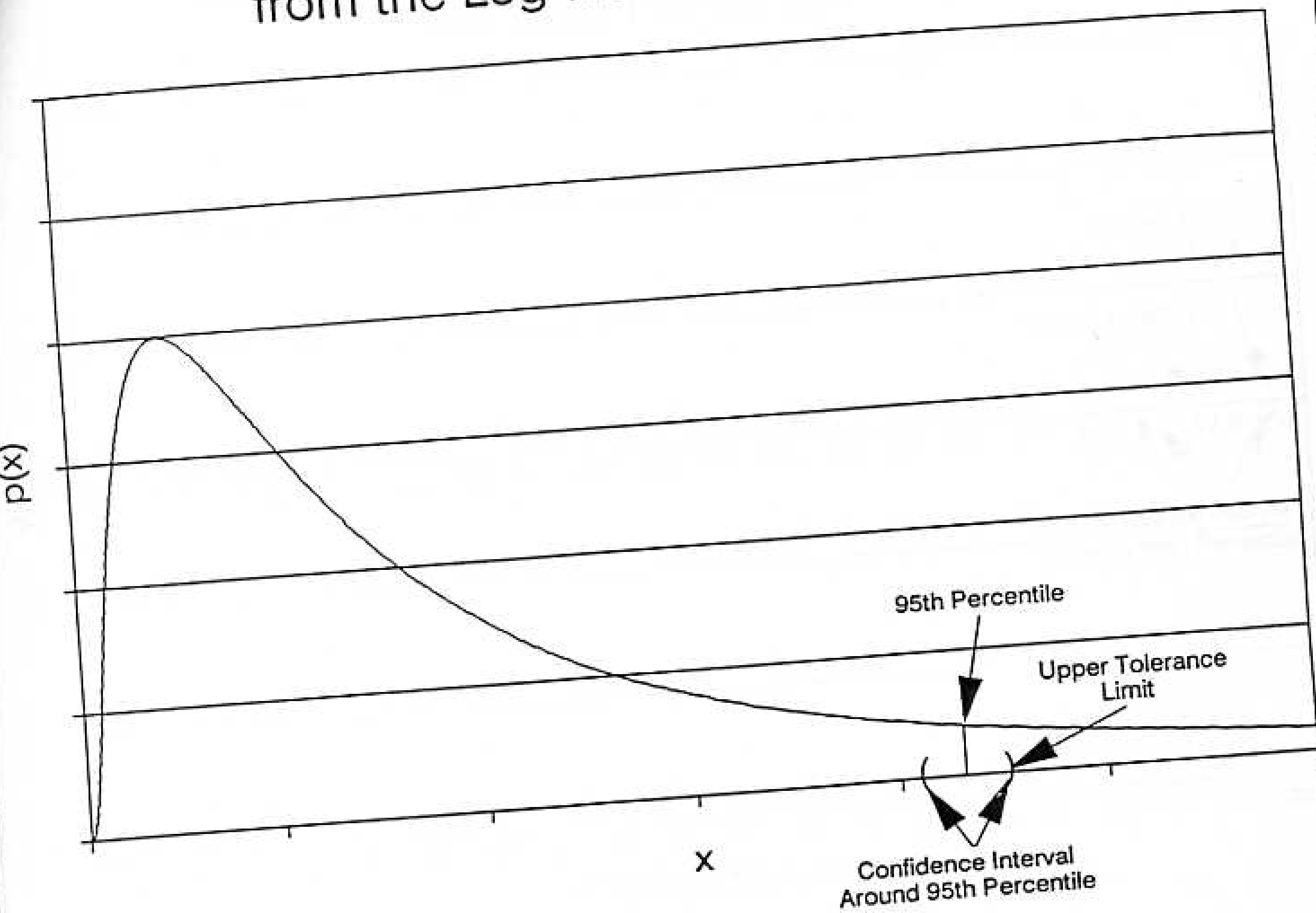
U.S. Environmental Protection Agency (1989) Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities - Interim Final Guidance, Office of Solid Waste, Washington, D.C.

# Estimating the 95th Percentile from the Normal Distribution




| FLAMBEAU MINING CO. - LADYSMITH, WISCONSIN | | | |
|---|---|---|---|
| FIGURE 1<br>NORMAL DISTRIBUTION CURVE | | | |
| Scale: | AS SHOWN | Date: | MAY, 1993 |
| Prepared By: | Foth & Van Dyke | By: | JOW |

# Estimating the 95th Percentile from the Log-Normal Distribution



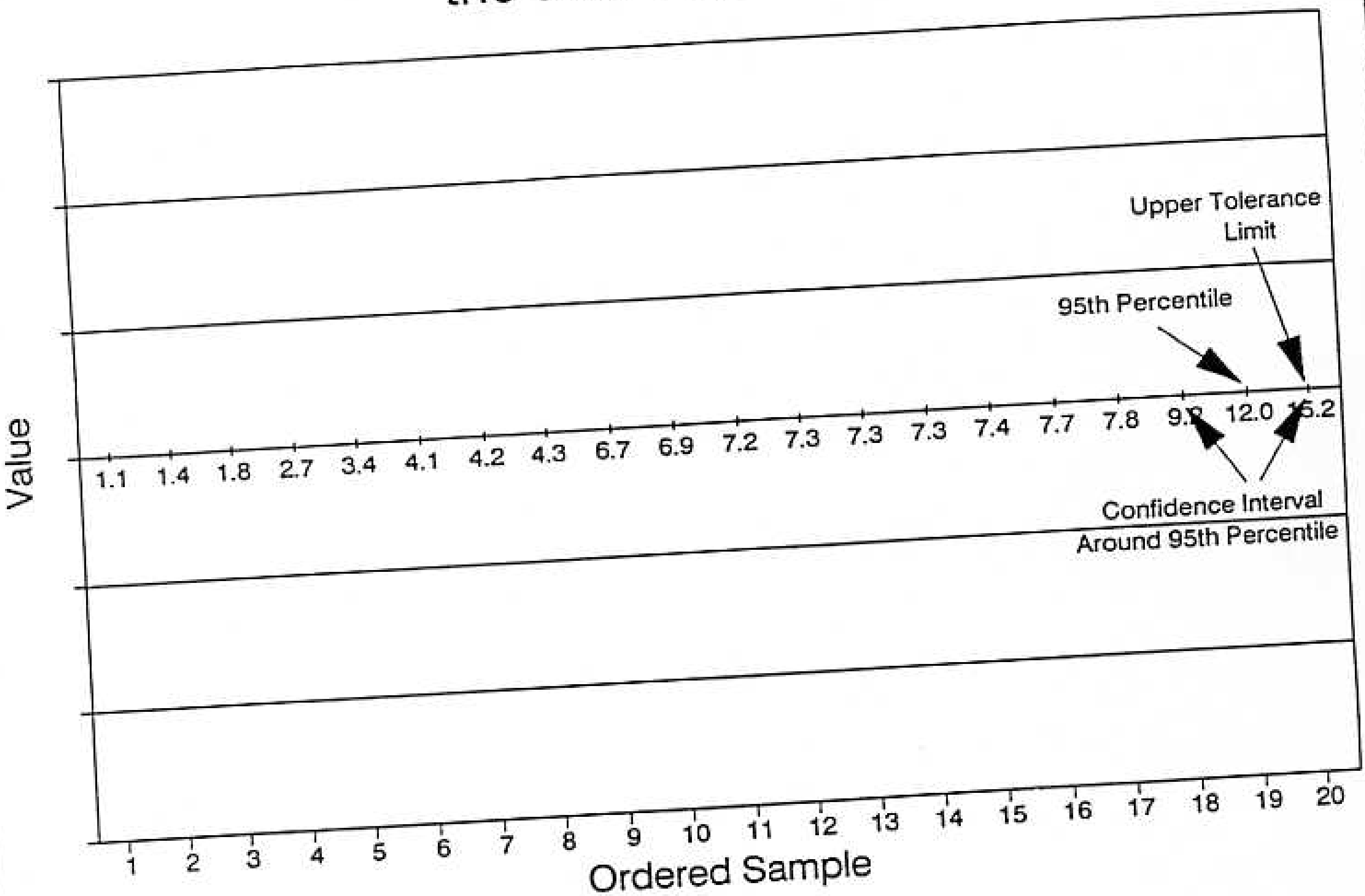

FLAMBEAU MINING CO. - LADYSMITH, WISCONSIN

FIGURE 2

LOG-NORMAL DISTRIBUTION CURVE

| | |
|---|---|
| Scale: AS SHOWN | Date: MAY, 1993 |
| Prepared By: Foth & Van Dyke | By: JOW |

# Non-Parametric Method of Estimating the 95th Percentile




| FLAMBEAU MINING CO. - LADYSMITH, WISCONSIN | | |
|---|---|---|
| FIGURE 3<br>NON-PARAMETRIC METHOD | | |
| Scale: AS SHOWN | Date: MAY, 1993 | |
| Prepared By: Foth & Van Dyke | | By: JC |

# Attachment 1

# MW-1000 and MW-1000R Groundwater Data

MW-1000 Historical Data and
MW-1000R January 1993 Data

Flambeau Mining Co.

| Well ID | DATE | Units | Fe | Mn | TDS |
|---|---|---|---|---|---|
| MW-1000 | Oct-87 | mg/l | 0.11 | 0.09 | 110 |
| MW-1000 | Nov-87 | mg/l | <0.10 | 0.10 | 250 |
| MW-1000 | Dec-87 | mg/l | <0.10 | 0.11 | 64 |
| MW-1000 | Jan-88 | mg/l | <0.10 | <0.05 | 100 |
| MW-1000 | Feb-88 | mg/l | <0.10 | <0.05 | 67 |
| MW-1000 | Mar-88 | mg/l | 0.15 | <0.05 | 64 |
| MW-1000 | Apr-88 | mg/l | <0.10 | <0.05 | 33 |
| MW-1000 | May-88 | mg/l | <0.10 | <0.05 | 120 |
| MW-1000 | Jun-88 | mg/l | <0.10 | <0.05 | 120 |
| MW-1000 | Jul-88 | mg/l | 0.16 | <0.05 | 120 |
| MW-1000 | Aug-88 | mg/l | 0.20 | <0.05 | 100 |
| MW-1000 | Sep-88 | mg/l | <0.10 | <0.05 | 50 |
| MW-1000 | Apr-89 | mg/l | - | - | - |
| MW-1000 | Jul-89 | mg/l | - | - | - |
| MW-1000 | Nov-89 | mg/l | - | - | - |
| MW-1000 | Jan-90 | mg/l | - | - | - |
| MW-1000 | Apr-90 | mg/l | - | - | - |
| MW-1000 | Aug-90 | mg/l | - | - | - |
| MW-1000 | Oct-90 | mg/l | - | - | - |
| MW-1000 | Apr-91 | mg/l | - | - | - |
| MW-1000 | Jul-91 | mg/l | <0.055 | <0.004 | 160 |
| MW-1000 | Oct-91 | mg/l | <0.055 | 0.004 | 180 |
| MW-1000 | Jan-92 | mg/l | <0.055 | 0.0061 | 110 |
| MW-1000 | Apr-92 | mg/l | 0.250 | 0.0071 | 130 |
| MW-1000 | Jul-92 | mg/l | <0.055 | 0.0056 | 120 |
| MW-1000 | Oct-92 | mg/l | <0.055 | <0.004 | <50 |
| MW-1000R | Jan-93 | mg/l | 0.73 | 0.13 | 62 |

- No Sample Collected



Prepared By: SGL Checked By: JBK

## Attachment 2

## Summary Statistics and Upper Tolerance Limits

Summary Statistics and
Upper Tolerance Limits

Flambeau Mining Co.

| Well ID | DATE | Units | Fe | Mn | TDS |
|---|---|---|---|---|---|
| MW-1000P | Oct-87 | mg/l | 0.12 | 0.26 | N.I. |
| MW-1000P | Nov-87 | mg/l | 0.15 | 0.46 | N.I. |
| MW-1000P | Dec-87 | mg/l | 0.11 | 0.59 | N.I. |
| MW-1000P | Jan-88 | mg/l | <0.10 | 0.55 | N.I. |
| MW-1000P | Feb-88 | mg/l | <0.10 | 0.61 | N.I. |
| MW-1000P | Mar-88 | mg/l | <0.10 | 0.65 | N.I. |
| MW-1000P | Apr-88 | mg/l | <0.10 | 0.64 | N.I. |
| MW-1000P | May-88 | mg/l | <0.10 | 0.59 | N.I. |
| MW-1000P | Jun-88 | mg/l | <0.10 | 0.70 | N.I. |
| MW-1000P | Jul-88 | mg/l | 0.20 | 0.72 | N.I. |
| MW-1000P | Aug-88 | mg/l | 0.11 | 0.75 | N.I. |
| MW-1000P | Sep-88 | mg/l | 0.45 | 0.73 | N.I. |
| MW-1000P | Apr-89 | mg/l | - | - | N.I. |
| MW-1000P | Jul-89 | mg/l | - | - | N.I. |
| MW-1000P | Nov-89 | mg/l | - | - | N.I. |
| MW-1000P | Jan-90 | mg/l | - | - | N.I. |
| MW-1000P | Apr-90 | mg/l | - | - | N.I. |
| MW-1000P | Aug-90 | mg/l | - | - | N.I. |
| MW-1000P | Oct-90 | mg/l | - | - | N.I. |
| MW-1000P | Apr-91 | mg/l | - | - | N.I. |
| MW-1000P | Jul-91 | mg/l | 0.65 | 0.85 | N.I. |
| MW-1000P | Oct-91 | mg/l | 0.84 | 0.88 | N.I. |
| MW-1000P | Jan-92 | mg/l | 1.70 | 0.82 | N.I. |
| MW-1000P | Apr-92 | mg/l | 1.30 | 0.83 | N.I. |
| MW-1000P | Jul-92 | mg/l | 0.47 | 0.73 | N.I. |
| MW-1000P | Oct-92 | mg/l | 0.80 | 0.78 | N.I. |
| MW-1000P | Jan-93 | mg/l | 0.15 | 0.71 | N.I. |
| Total Samples | | | 19 | 19 | N.I. |
| Number of Detections | | | 13 | 19 | N.I. |
| Upper Tolerance Limit* | | | 3.80(2) | 1.04(1) | N.I. |
| Current Site MCL | | | 0.30 | 0.230 | 500 |

- No Sample Collected

* Upper Tolerance Limit is Equal to Upper 95th Confidence Limit on 95th Percentile (Proposed Alternate Concentration Limit)

N.I. - Values Not Included; No Alternate Concentration Limit Proposed

(1) Calculated Assuming Normal Distribution

(2) Calculated Assuming Log-Normal Distribution

(3) Calculated With Nonparametric Methods (No Distributional Assumptions)



Prepared By: SGL Checked By: JBK

Summary Statistics and
Upper Tolerance Limits

Flambeau Mining Co.

| Well ID | DATE | Units | Fe | Mn | TDS |
|---|---|---|---|---|---|
| MW-1002 | Oct-87 | mg/l | N.I. | 0.20 | N.I. |
| MW-1002 | Nov-87 | mg/l | N.I. | 0.21 | N.I. |
| MW-1002 | Dec-87 | mg/l | N.I. | 0.15 | N.I. |
| MW-1002 | Jan-88 | mg/l | N.I. | <0.05 | N.I. |
| MW-1002 | Feb-88 | mg/l | N.I. | <0.05 | N.I. |
| MW-1002 | Mar-88 | mg/l | N.I. | <0.05 | N.I. |
| MW-1002 | Apr-88 | mg/l | N.I. | <0.05 | N.I. |
| MW-1002 | May-88 | mg/l | N.I. | <0.05 | N.I. |
| MW-1002 | Jun-88 | mg/l | N.I. | <0.05 | N.I. |
| MW-1002 | Jul-88 | mg/l | N.I. | <0.05 | N.I. |
| MW-1002 | Aug-88 | mg/l | N.I. | <0.05 | N.I. |
| MW-1002 | Sep-88 | mg/l | N.I. | <0.05 | N.I. |
| MW-1002 | Apr-89 | mg/l | N.I. | - | N.I. |
| MW-1002 | Jul-89 | mg/l | N.I. | - | N.I. |
| MW-1002 | Nov-89 | mg/l | N.I. | - | N.I. |
| MW-1002 | Jan-90 | mg/l | N.I. | - | N.I. |
| MW-1002 | Apr-90 | mg/l | N.I. | - | N.I. |
| MW-1002 | Aug-90 | mg/l | N.I. | - | N.I. |
| MW-1002 | Oct-90 | mg/l | N.I. | - | N.I. |
| MW-1002 | Apr-91 | mg/l | N.I. | - | N.I. |
| MW-1002 | Jul-91 | mg/l | N.I. | 0.0051 | N.I. |
| MW-1002 | Oct-91 | mg/l | N.I. | <0.004 | N.I. |
| MW-1002 | Jan-92 | mg/l | N.I. | <0.004 | N.I. |
| MW-1002 | Apr-92 | mg/l | N.I. | <0.004 | N.I. |
| MW-1002 | Jul-92 | mg/l | N.I. | <0.004 | N.I. |
| MW-1002 | Oct-92 | mg/l | N.I. | 0.015 | N.I. |
| MW-1002 | Jan-93 | mg/l | N.I. | 0.0047 | N.I. |
| Total Samples | | | N.I. | 19 | N.I. |
| Number of Detections | | | N.I. | 6 | N.I. |
| Upper Tolerance Limit* | | | N.I. | 0.210(3) | N.I. |
| Current Site MCL | | | 0.30 | 0.090 | 500 |

- No Sample Collected

* Upper Tolerance Limit is Equal to Upper 95th Confidence
Limit on 95th Percentile (Proposed Alternate Concentration Limit)

N.I. - Values Not Included; No Alternate Concentration Limit Proposed

(1) Calculated Assuming Normal Distribution

(2) Calculated Assuming Log-Normal Distribution

(3) Calculated With Nonparametric Methods (No Distributional Assumptions)



Prepared By: SGL Checked By: JB

Summary Statistics and
Upper Tolerance Limits

Flambeau Mining Co.

| Well ID | DATE | Units | Fe | Mn | TDS |
|---|---|---|---|---|---|
| MW-1004 | Oct-87 | mg/l | N.I. | <0.05 | 570 |
| MW-1004 | Nov-87 | mg/l | N.I. | 0.28 | 400 |
| MW-1004 | Dec-87 | mg/l | N.I. | 0.07 | 800 |
| MW-1004 | Jan-88 | mg/l | N.I. | <0.05 | 280 |
| MW-1004 | Feb-88 | mg/l | N.I. | 0.05 | 220 |
| MW-1004 | Mar-88 | mg/l | N.I. | <0.05 | 240 |
| MW-1004 | Apr-88 | mg/l | N.I. | <0.05 | 31 |
| MW-1004 | May-88 | mg/l | N.I. | <0.05 | 360 |
| MW-1004 | Jun-88 | mg/l | N.I. | <0.05 | 130 |
| MW-1004 | Jul-88 | mg/l | N.I. | <0.05 | 130 |
| MW-1004 | Aug-88 | mg/l | N.I. | <0.05 | 120 |
| MW-1004 | Sep-88 | mg/l | N.I. | 0.06 | 77 |
| MW-1004 | Apr-89 | mg/l | N.I. | - | - |
| MW-1004 | Jul-89 | mg/l | N.I. | - | - |
| MW-1004 | Nov-89 | mg/l | N.I. | - | - |
| MW-1004 | Jan-90 | mg/l | N.I. | - | - |
| MW-1004 | Apr-90 | mg/l | N.I. | - | - |
| MW-1004 | Aug-90 | mg/l | N.I. | - | - |
| MW-1004 | Oct-90 | mg/l | N.I. | - | - |
| MW-1004 | Apr-91 | mg/l | N.I. | - | - |
| MW-1004 | Jul-91 | mg/l | N.I. | 0.0044 | 190 |
| MW-1004 | Oct-91 | mg/l | N.I. | <0.004 | 150 |
| MW-1004 | Jan-92 | mg/l | N.I. | <0.004 | 65 |
| MW-1004 | Apr-92 | mg/l | N.I. | <0.004 | 82 |
| MW-1004 | Jul-92 | mg/l | N.I. | 0.057 | 77 |
| MW-1004 | Oct-92 | mg/l | N.I. | <0.004 | 48 |
| MW-1004 | Jan-93 | mg/l | N.I. | <0.004 | 57 |
| | | | | | |
| Total Samples | | | N.I. | 19 | 19 |
| Number of Detections | | | N.I. | 6 | 19 |
| Upper Tolerance Limit* | | | N.I. | 0.280(3) | 1234(2) |
| Current Site MCL | | | 0.30 | 0.090 | 500 |

- No Sample Collected

* Upper Tolerance Limit is Equal to Upper 95th Confidence Limit on 95th Percentile (Proposed Alternate Concentration Limit)

N.I. - Values Not Included; No Alternate Concentration Limit Proposed

(1) Calculated Assuming Normal Distribution

(2) Calculated Assuming Log-Normal Distribution

(3) Calculated With Nonparametric Methods (No Distributional Assumptions)



Prepared By: SGL Checked By: JBK

Summary Statistics and
Upper Tolerance Limits

Flambeau Mining Co.

| Well ID | DATE | Units | Fe | Mn | TDS |
|---|---|---|---|---|---|
| MW-1004P | Oct-87 | mg/l | <0.10 | N.I. | N.I. |
| MW-1004P | Nov-87 | mg/l | <0.10 | N.I. | N.I. |
| MW-1004P | Dec-87 | mg/l | <0.10 | N.I. | N.I. |
| MW-1004P | Jan-88 | mg/l | 0.10 | N.I. | N.I. |
| MW-1004P | Feb-88 | mg/l | 0.55 | N.I. | N.I. |
| MW-1004P | Mar-88 | mg/l | <0.10 | N.I. | N.I. |
| MW-1004P | Apr-88 | mg/l | 0.14 | N.I. | N.I. |
| MW-1004P | May-88 | mg/l | <0.10 | N.I. | N.I. |
| MW-1004P | Jun-88 | mg/l | <0.10 | N.I. | N.I. |
| MW-1004P | Jul-88 | mg/l | 0.19 | N.I. | N.I. |
| MW-1004P | Aug-88 | mg/l | <0.06 | N.I. | N.I. |
| MW-1004P | Sep-88 | mg/l | <0.10 | N.I. | N.I. |
| MW-1004P | Apr-89 | mg/l | 0.26 | N.I. | N.I. |
| MW-1004P | Jul-89 | mg/l | 0.63 | N.I. | N.I. |
| MW-1004P | Nov-89 | mg/l | 0.25 | N.I. | N.I. |
| MW-1004P | Jan-90 | mg/l | 0.33 | N.I. | N.I. |
| MW-1004P | Apr-90 | mg/l | 0.20 | N.I. | N.I. |
| MW-1004P | Aug-90 | mg/l | 0.31 | N.I. | N.I. |
| MW-1004P | Oct-90 | mg/l | 0.22 | N.I. | N.I. |
| MW-1004P | Apr-91 | mg/l | 0.32 | N.I. | N.I. |
| MW-1004P | Jul-91 | mg/l | 0.33 | N.I. | N.I. |
| MW-1004P | Oct-91 | mg/l | 0.22 | N.I. | N.I. |
| MW-1004P | Jan-92 | mg/l | 0.32 | N.I. | N.I. |
| MW-1004P | Apr-92 | mg/l | 0.37 | N.I. | N.I. |
| MW-1004P | Jul-92 | mg/l | 0.38 | N.I. | N.I. |
| MW-1004P | Oct-92 | mg/l | 0.32 | N.I. | N.I. |
| MW-1004P | Jan-93 | mg/l | 0.39 | N.I. | N.I. |
| Total Samples | | | 27 | N.I. | N.I. |
| Number of Detections | | | 19 | N.I. | N.I. |
| Upper Tolerance Limit* | | | 0.60(1) | N.I. | N.I. |
| Current Site MCL | | | 0.30 | 0.230 | 500 |

- No Sample Collected

* Upper Tolerance Limit is Equal to Upper 95th Confidence Limit on 95th Percentile (Proposed Alternate Concentration Limit)

N.I. - Values Not Included; No Alternate Concentration Limit Proposed

(1) Calculated Assuming Normal Distribution

(2) Calculated Assuming Log-Normal Distribution

(3) Calculated With Nonparametric Methods (No Distributional Assumptions)



Prepared By: SGL Checked By: JBK

Summary Statistics and
Upper Tolerance Limits

Flambeau Mining Co.

| Well ID | DATE | Units | Fe | Mn | TDS |
|---|---|---|---|---|---|
| MW-1005 | Oct-87 | mg/l | 7.2 | 1.40 | 640 |
| MW-1005 | Nov-87 | mg/l | 6.1 | 1.10 | 610 |
| MW-1005 | Dec-87 | mg/l | 13.0 | 0.75 | 650 |
| MW-1005 | Jan-88 | mg/l | 12.0 | 0.65 | 640 |
| MW-1005 | Feb-88 | mg/l | 12.0 | 0.75 | 550 |
| MW-1005 | Mar-88 | mg/l | 7.9 | 0.71 | 630 |
| MW-1005 | Apr-88 | mg/l | 3.5 | 0.63 | 580 |
| MW-1005 | May-88 | mg/l | 15.0 | 0.56 | 730 |
| MW-1005 | Jun-88 | mg/l | 21.0 | 0.62 | 770 |
| MW-1005 | Jul-88 | mg/l | 19.0 | 0.64 | 650 |
| MW-1005 | Aug-88 | mg/l | 1.1 | 0.45 | 1000 |
| MW-1005 | Sep-88 | mg/l | 12.0 | 0.56 | 690 |
| MW-1005 | Apr-89 | mg/l | 12.0 | - | - |
| MW-1005 | Jul-89 | mg/l | 7.8 | - | - |
| MW-1005 | Nov-89 | mg/l | 18.0 | - | - |
| MW-1005 | Jan-90 | mg/l | 20.0 | - | - |
| MW-1005 | Apr-90 | mg/l | 16.0 | - | - |
| MW-1005 | Aug-90 | mg/l | 17.0 | - | - |
| MW-1005 | Oct-90 | mg/l | 14.0 | - | - |
| MW-1005 | Apr-91 | mg/l | 15.0 | - | - |
| MW-1005 | Jul-91 | mg/l | 17.0 | 0.51 | 570 |
| MW-1005 | Oct-91 | mg/l | 20.0 | 0.49 | 770 |
| MW-1005 | Jan-92 | mg/l | 18.0 | 0.46 | 530 |
| MW-1005 | Apr-92 | mg/l | 17.0 | 0.38 | 680 |
| MW-1005 | Jul-92 | mg/l | 19.0 | 0.44 | 640 |
| MW-1005 | Oct-92 | mg/l | 22.0 | 0.47 | 600 |
| MW-1005 | Jan-93 | mg/l | 24.0 | 0.52 | 140 |
| Total Samples | | | 27 | 19 | 19 |
| Number of Detections | | | 27 | 19 | 19 |
| Upper Tolerance Limit* | | | 27.6(1) | 1.31(2) | 1000(3) |
| Current Site MCL | | | 0.30 | 0.090 | 500 |

- No Sample Collected

* Upper Tolerance Limit is Equal to Upper 95th Confidence Limit on 95th Percentile (Proposed Alternate Concentration Limit)

N.I. - Values Not Included; No Alternate Concentration Limit Proposed

(1) Calculated Assuming Normal Distribution

(2) Calculated Assuming Log-Normal Distribution

(3) Calculated With Nonparametric Methods (No Distributional Assumptions)



Prepared By: SGL Checked By: JBK

Summary Statistics and
Upper Tolerance Limits

Flambeau Mining Co.

| Well ID | DATE | Units | Fe | Mn | TDS |
|---|---|---|---|---|---|
| MW-1005S | Oct-87 | mg/l | 4.00 | 0.23 | N.I. |
| MW-1005S | Nov-87 | mg/l | 3.10 | 0.28 | N.I. |
| MW-1005S | Dec-87 | mg/l | 4.00 | 0.29 | N.I. |
| MW-1005S | Jan-88 | mg/l | 3.00 | 0.25 | N.I. |
| MW-1005S | Feb-88 | mg/l | 3.10 | 0.29 | N.I. |
| MW-1005S | Mar-88 | mg/l | 2.60 | 0.26 | N.I. |
| MW-1005S | Apr-88 | mg/l | 4.30 | 0.26 | N.I. |
| MW-1005S | May-88 | mg/l | 2.10 | 0.28 | N.I. |
| MW-1005S | Jun-88 | mg/l | 1.90 | 0.26 | N.I. |
| MW-1005S | Jul-88 | mg/l | 4.00 | 0.24 | N.I. |
| MW-1005S | Aug-88 | mg/l | 3.40 | 0.27 | N.I. |
| MW-1005S | Sep-88 | mg/l | 3.10 | 0.27 | N.I. |
| MW-1005S | Apr-89 | mg/l | 3.20 | - | N.I. |
| MW-1005S | Jul-89 | mg/l | 3.80 | - | N.I. |
| MW-1005S | Nov-89 | mg/l | 3.30 | - | N.I. |
| MW-1005S | Jan-90 | mg/l | 3.40 | - | N.I. |
| MW-1005S | Apr-90 | mg/l | 2.90 | - | N.I. |
| MW-1005S | Aug-90 | mg/l | 1.70 | - | N.I. |
| MW-1005S | Oct-90 | mg/l | 2.90 | - | N.I. |
| MW-1005S | Apr-91 | mg/l | 3.60 | - | N.I. |
| MW-1005S | Jul-91 | mg/l | 3.00 | 0.21 | N.I. |
| MW-1005S | Oct-91 | mg/l | 3.80 | 0.22 | N.I. |
| MW-1005S | Jan-92 | mg/l | 3.60 | 0.21 | N.I. |
| MW-1005S | Apr-92 | mg/l | 3.70 | 0.2 | N.I. |
| MW-1005S | Jul-92 | mg/l | 4.10 | 0.21 | N.I. |
| MW-1005S | Oct-92 | mg/l | 3.90 | 0.2 | N.I. |
| MW-1005S | Jan-93 | mg/l | 4.10 | 0.21 | N.I. |
| Total Samples | | | 27 | 19 | N.I. |
| Number of Detections | | | 27 | 19 | N.I. |
| Upper Tolerance Limit* | | | 4.88(1) | 0.32(1) | N.I. |
| Current Site MCL | | | 0.30 | 0.360 | 500 |

- No Sample Collected

* Upper Tolerance Limit Is Equal to Upper 95th Confidence Limit on 95th Percentile (Proposed Alternate Concentration Limit)

N.I. - Values Not Included; No Alternate Concentration Limit Proposed

(1) Calculated Assuming Normal Distribution

(2) Calculated Assuming Log-Normal Distribution

(3) Calculated With Nonparametric Methods (No Distributional Assumptions)

Prepared By: SGL Checked By: JB

Summary Statistics and
Upper Tolerance Limits

Flambeau Mining Co.

| Well ID | DATE | Units | Fe | Mn | TDS |
|---|---|---|---|---|---|
| MW-1005P | Oct-87 | mg/l | 0.38 | N.I. | N.I. |
| MW-1005P | Nov-87 | mg/l | 0.56 | N.I. | N.I. |
| MW-1005P | Dec-87 | mg/l | 0.18 | N.I. | N.I. |
| MW-1005P | Jan-88 | mg/l | 0.20 | N.I. | N.I. |
| MW-1005P | Feb-88 | mg/l | 0.22 | N.I. | N.I. |
| MW-1005P | Mar-88 | mg/l | 0.29 | N.I. | N.I. |
| MW-1005P | Apr-88 | mg/l | 0.54 | N.I. | N.I. |
| MW-1005P | May-88 | mg/l | 0.72 | N.I. | N.I. |
| MW-1005P | Jun-88 | mg/l | 0.27 | N.I. | N.I. |
| MW-1005P | Jul-88 | mg/l | 0.63 | N.I. | N.I. |
| MW-1005P | Aug-88 | mg/l | 0.95 | N.I. | N.I. |
| MW-1005P | Sep-88 | mg/l | <0.10 | N.I. | N.I. |
| MW-1005P | Apr-89 | mg/l | 0.26 | N.I. | N.I. |
| MW-1005P | Jul-89 | mg/l | 1.10 | N.I. | N.I. |
| MW-1005P | Nov-89 | mg/l | 1.00 | N.I. | N.I. |
| MW-1005P | Jan-90 | mg/l | 0.98 | N.I. | N.I. |
| MW-1005P | Apr-90 | mg/l | 0.70 | N.I. | N.I. |
| MW-1005P | Aug-90 | mg/l | 3.70 | N.I. | N.I. |
| MW-1005P | Oct-90 | mg/l | 0.89 | N.I. | N.I. |
| MW-1005P | Apr-91 | mg/l | 0.77 | N.I. | N.I. |
| MW-1005P | Jul-91 | mg/l | 1.20 | N.I. | N.I. |
| MW-1005P | Oct-91 | mg/l | 1.00 | N.I. | N.I. |
| MW-1005P | Jan-92 | mg/l | 0.75 | N.I. | N.I. |
| MW-1005P | Apr-92 | mg/l | 1.00 | N.I. | N.I. |
| MW-1005P | Jul-92 | mg/l | 0.95 | N.I. | N.I. |
| MW-1005P | Oct-92 | mg/l | 1.20 | N.I. | N.I. |
| MW-1005P | Jan-93 | mg/l | 1.10 | N.I. | N.I. |
| | | | | | |
| Total Samples | | | 27 | N.I. | N.I. |
| Number of Detections | | | 26 | N.I. | N.I. |
| Upper Tolerance Limit* | | | 4.17(2) | N.I. | N.I. |
| Current Site MCL | | | 0.30 | 0.230 | 500 |

- No Sample Collected

* Upper Tolerance Limit is Equal to Upper 95th Confidence Limit on 95th Percentile (Proposed Alternate Concentration Limit)

N.I. - Values Not Included; No Alternate Concentration Limit Proposed

(1) Calculated Assuming Normal Distribution

(2) Calculated Assuming Log-Normal Distribution

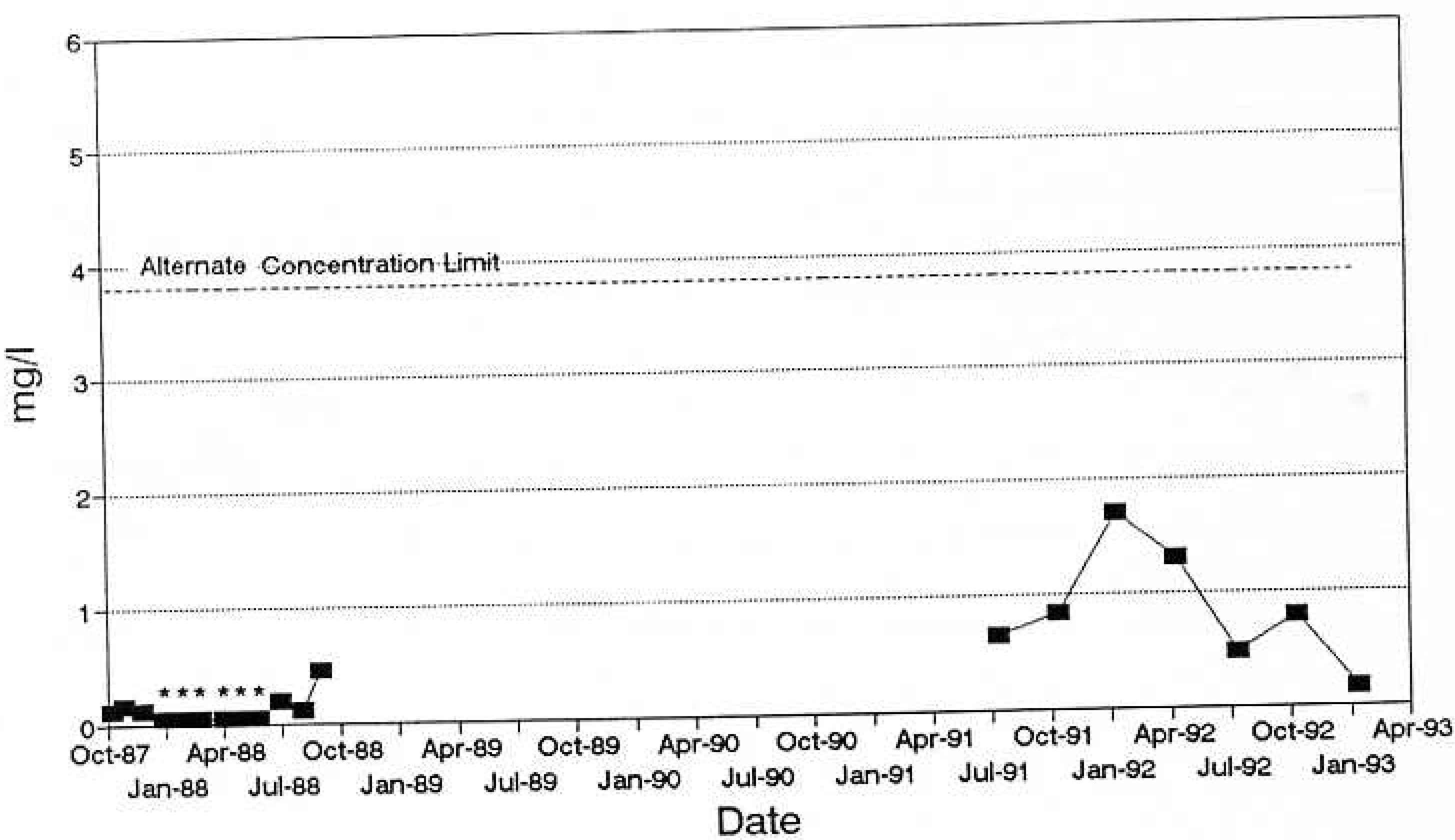
(3) Calculated With Nonparametric Methods (No Distributional Assumptions)

Prepared By: SGL Checked By: JBK

Attachment 3

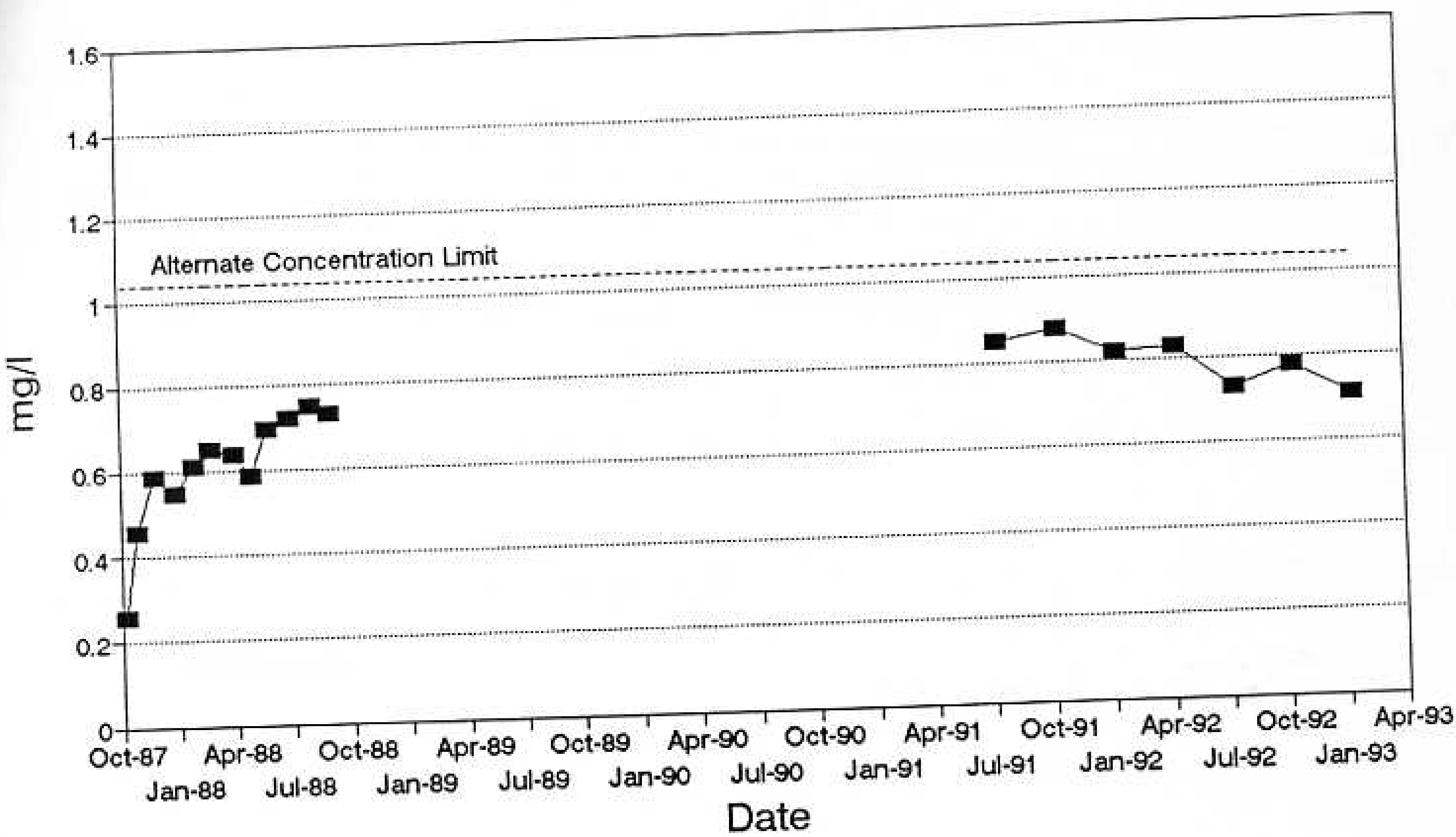
# Groundwater Quality Results and Alternate Concentration Limits

# Groundwater Quality Results
## Iron - MW1000P



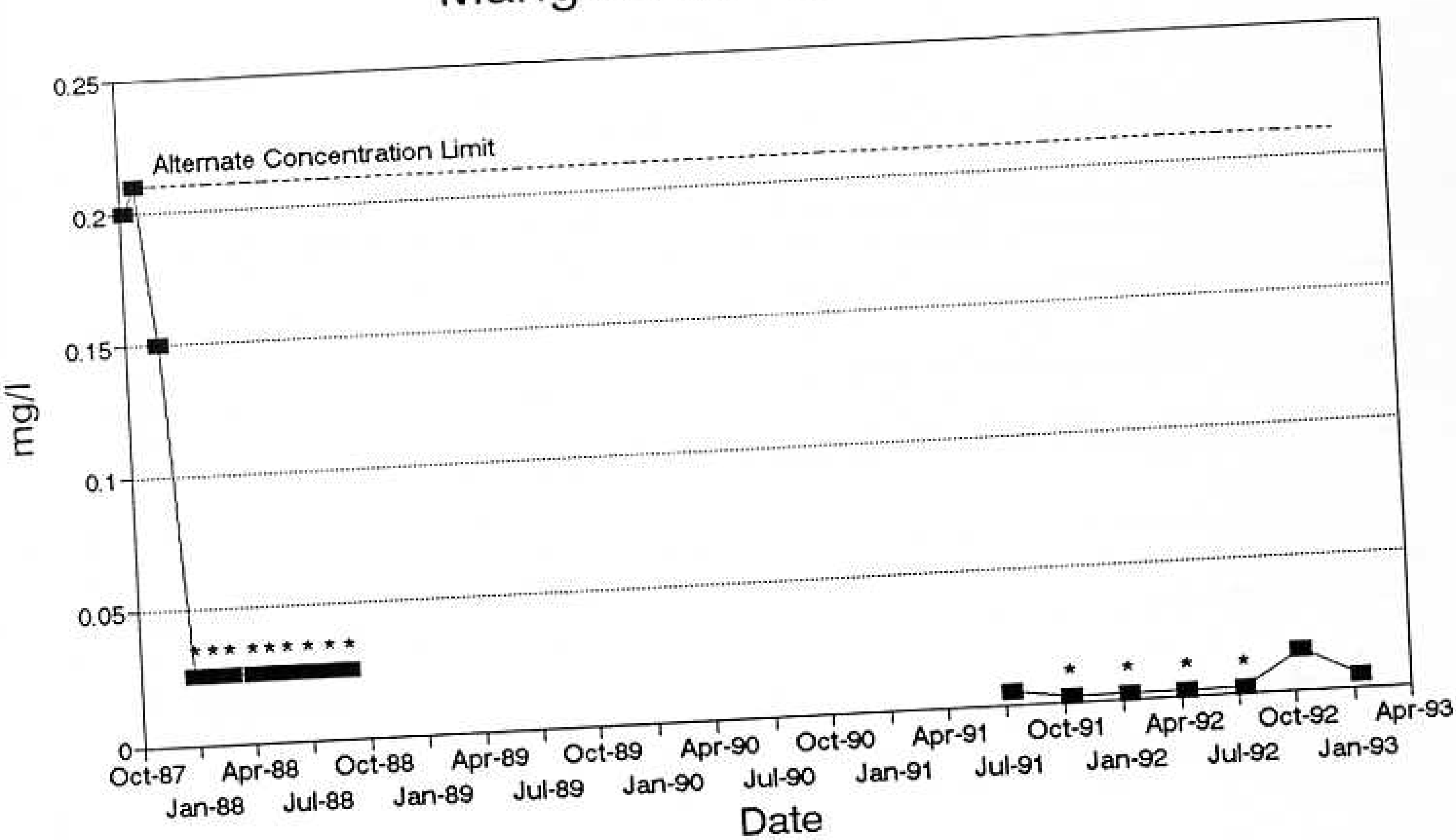

* Compound not detected, value = 1/2 detection limit

# Groundwater Quality Results
## Manganese - MW1000P



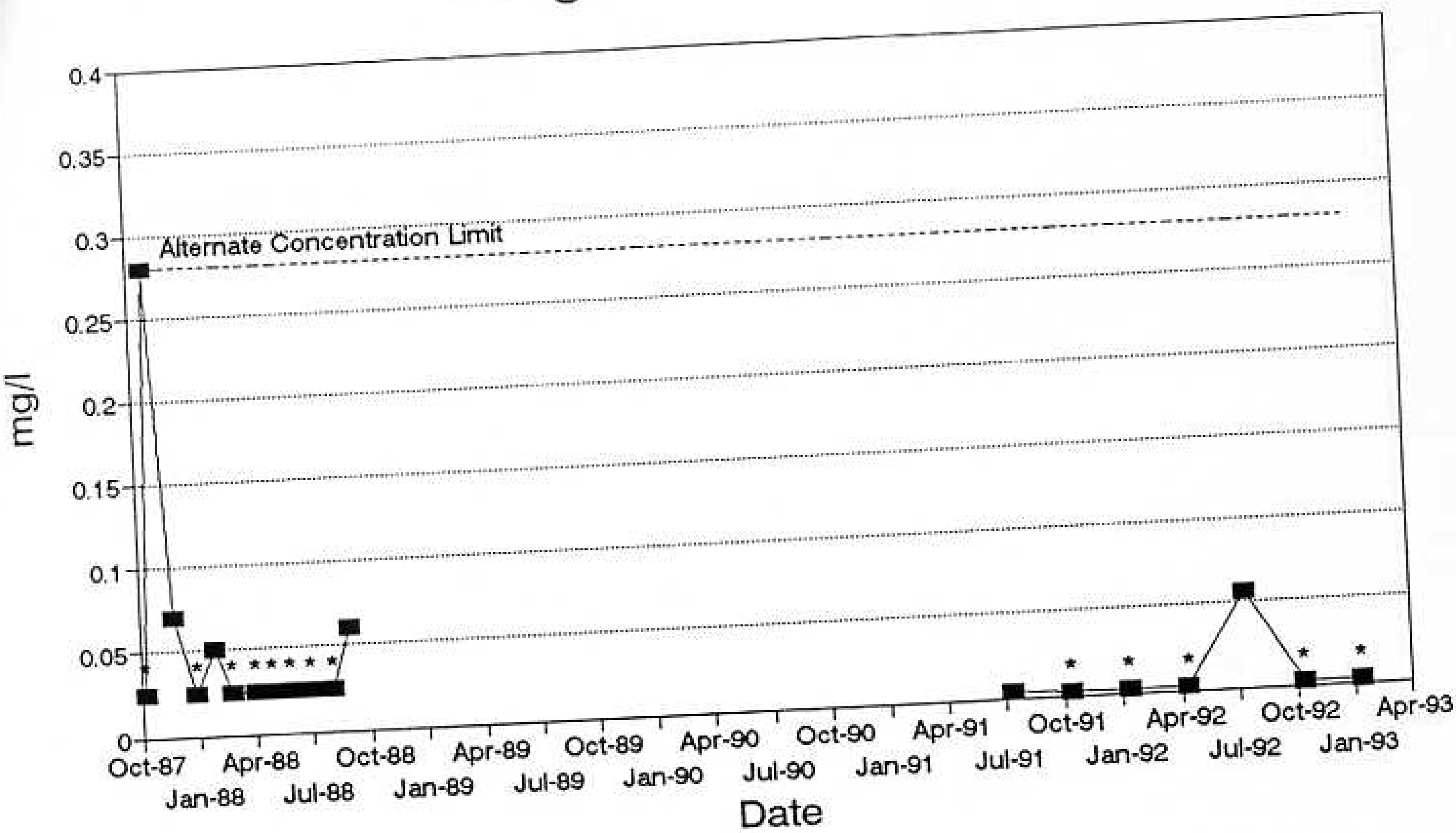

* Compound not detected, value = 1/2 detection limit

# Groundwater Quality Results
## Manganese - MW1002



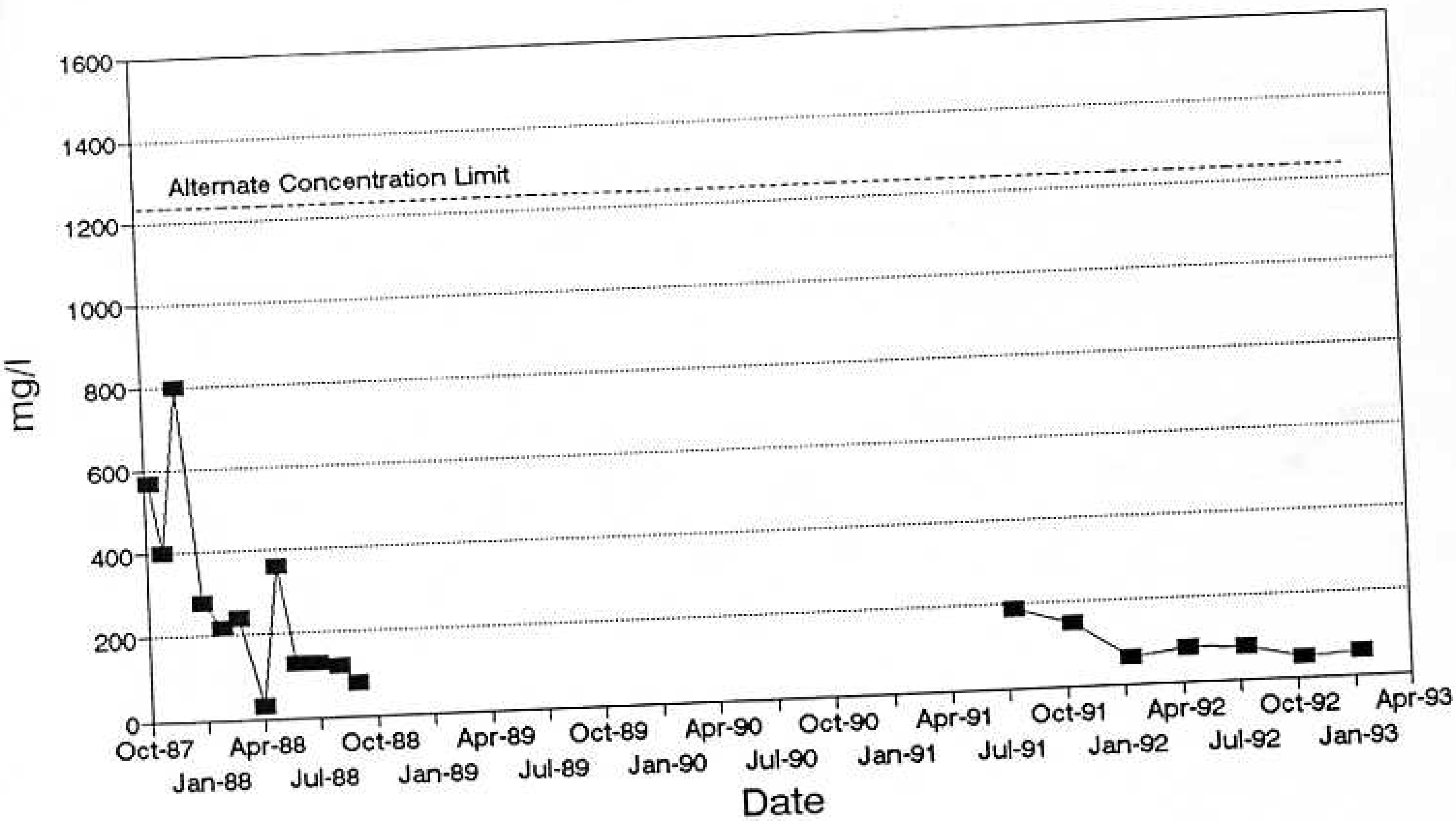

* Compound not detected, value = 1/2 detection limit.

# Groundwater Quality Results
## Manganese - MW1004



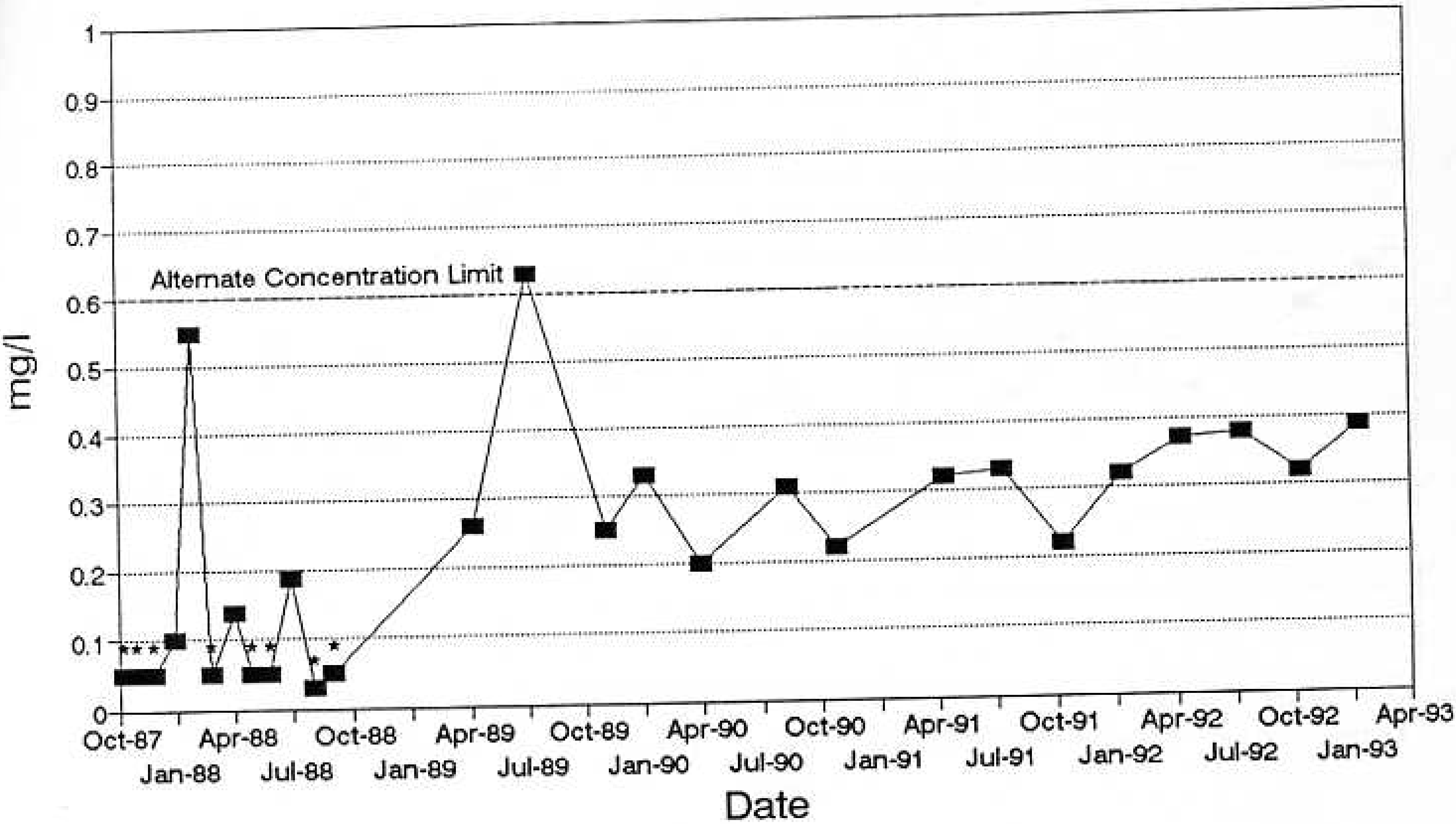

* Compound not detected, value = 1/2 detection limit

# Groundwater Quality Results
## TDS - MW1004

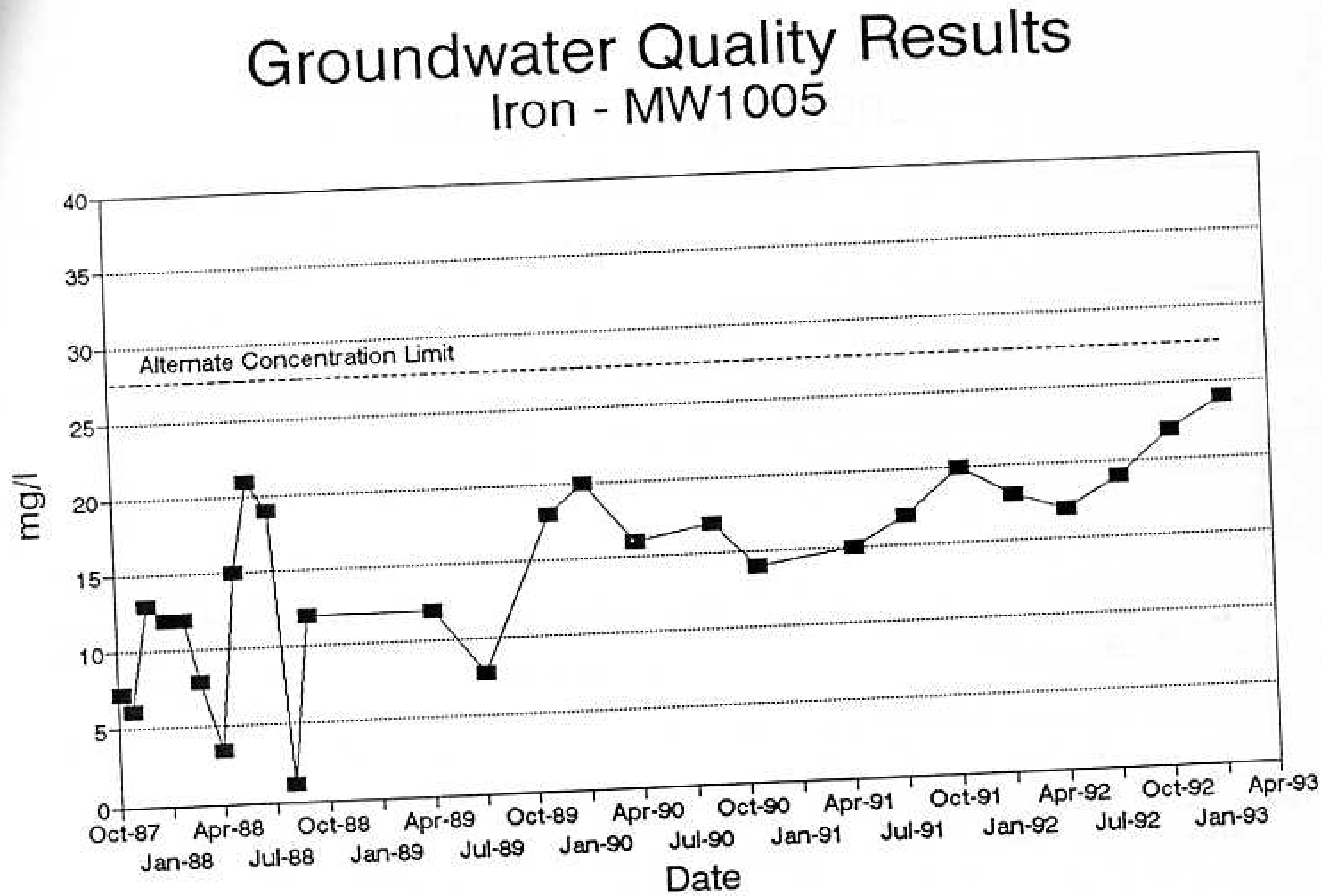



* Compound not detected, value = 1/2 detection limit

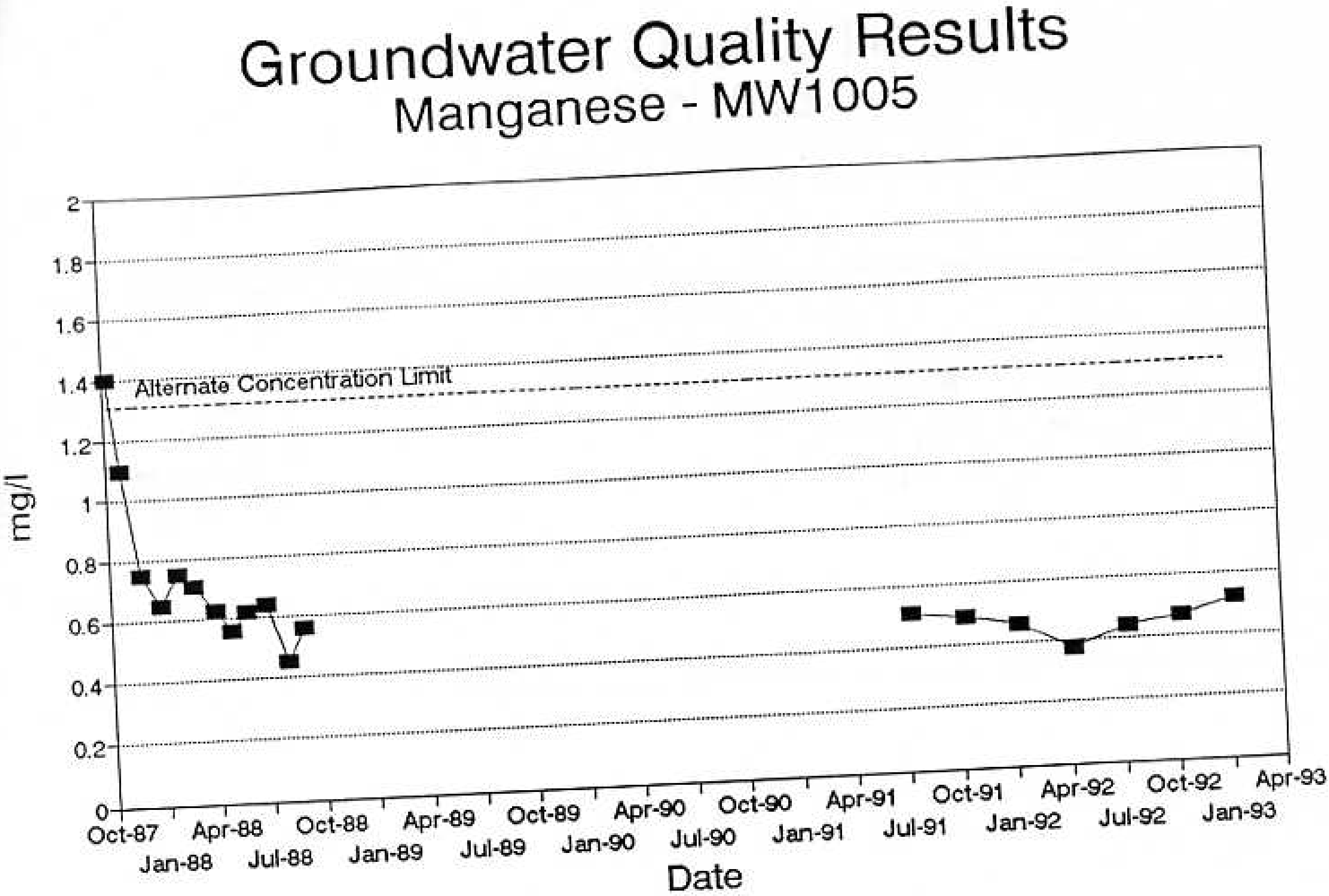
# Groundwater Quality Results
## Iron - MW1004P




* Compound not detected, value = 1/2 detection limit

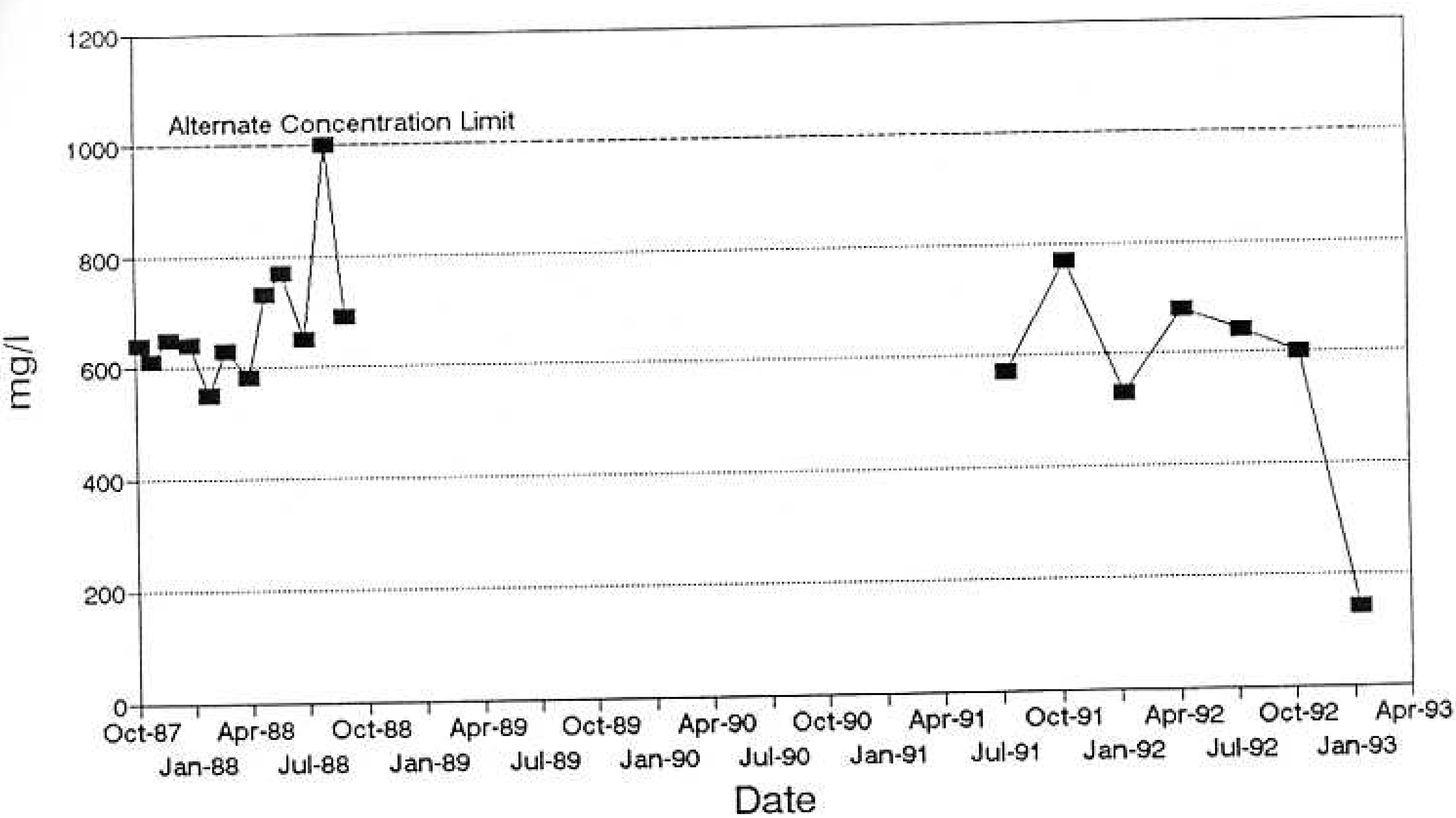



* Compound not detected, value = 1/2 detection limit



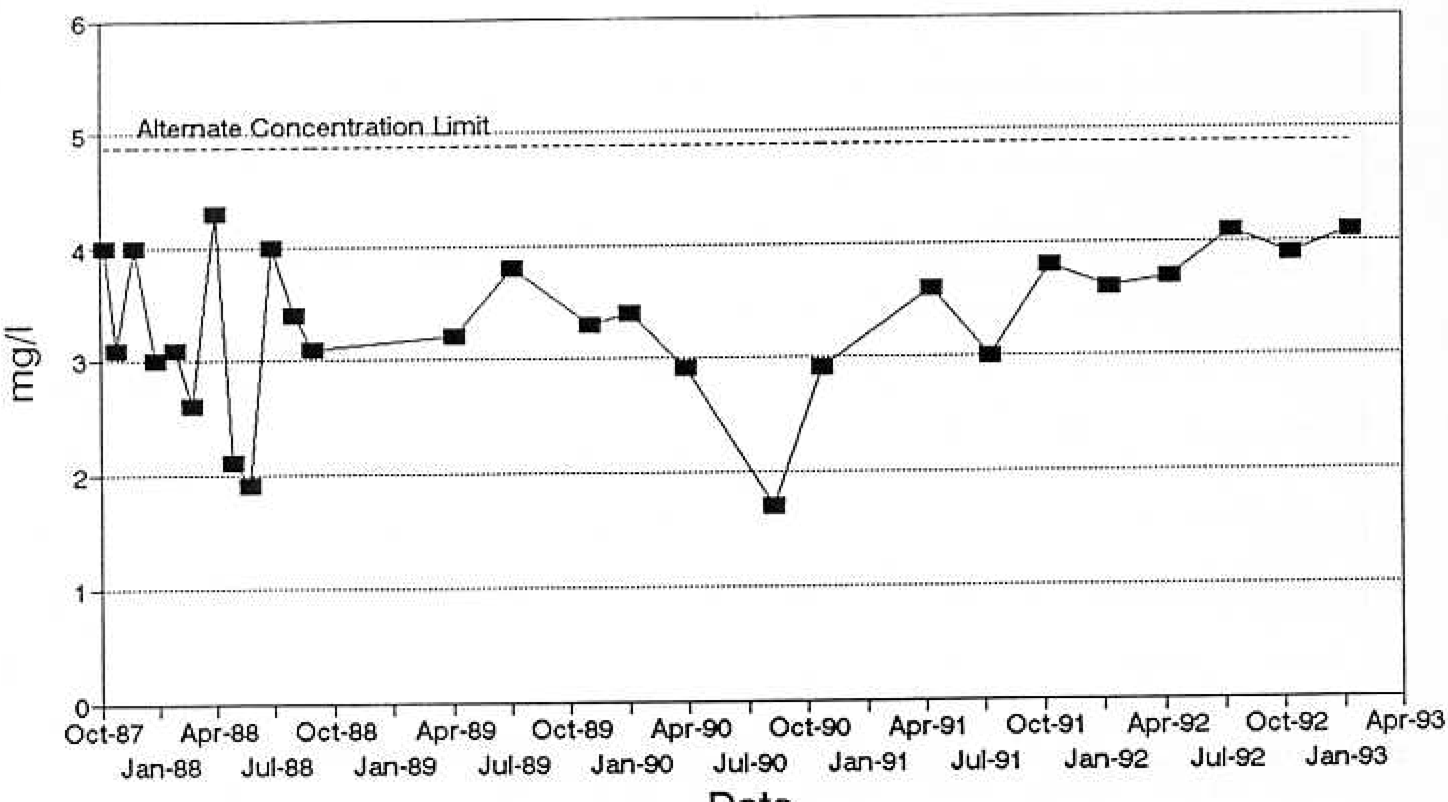

* Compound not detected, value = 1/2 detection limit

# Groundwater Quality Results
## TDS - MW1005



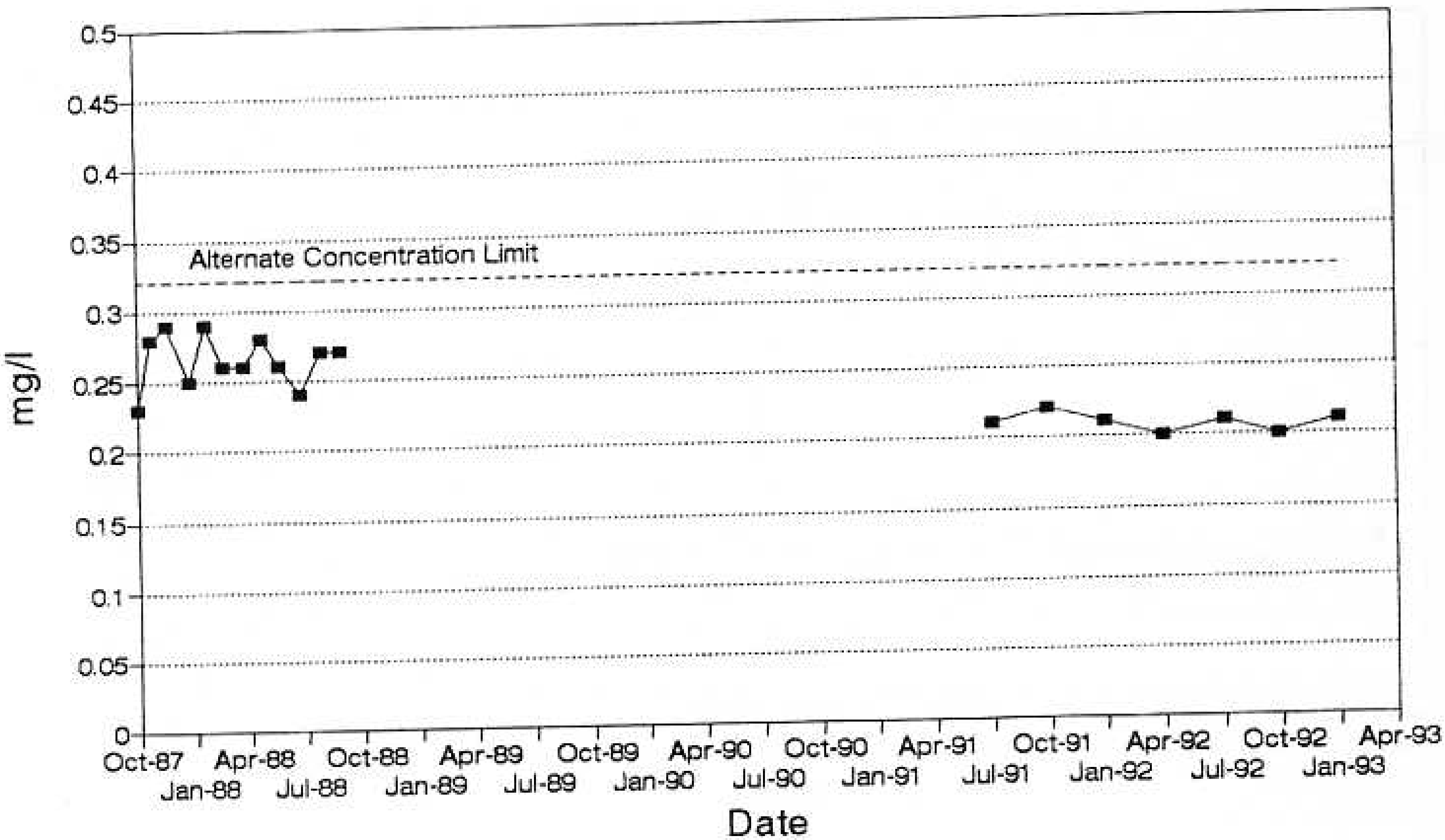

* Compound not detected, value = 1/2 detection limit

# Groundwater Quality Results
## Iron - MW1005S



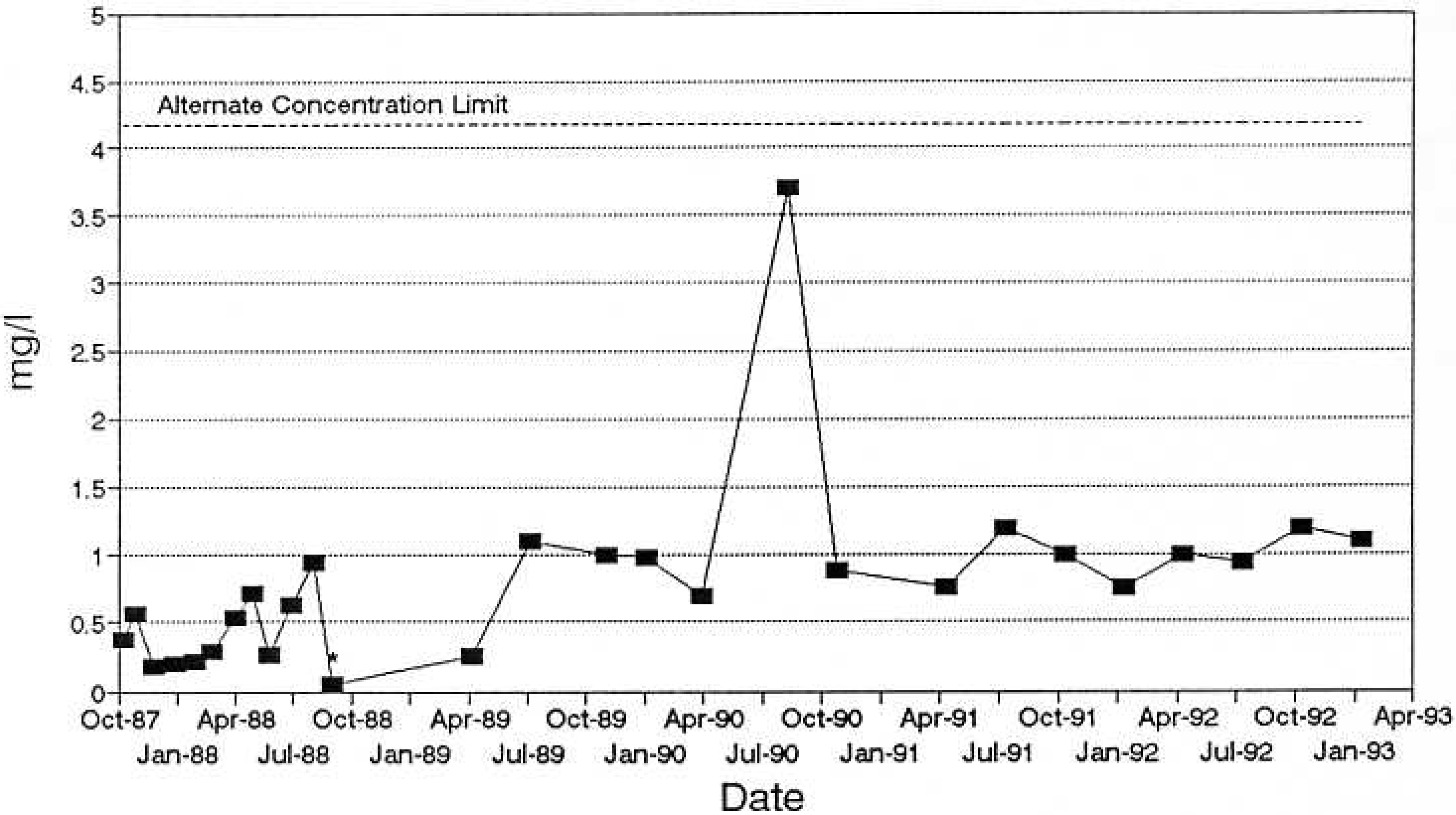

* Compound not detected, value = 1/2 detection limit

# Groundwater Quality Results
## Manganese - MW1005S




* Compound not detected, value = 1/2 detection limit.

# Groundwater Quality Results
## Iron - MW1005P




* Compound not detected, value = 1/2 detection limit.

## Attachment 4

## Tolerance Factors

TABLE 5. TOLERANCE FACTORS (K) FOR ONE-SIDED NORMAL TOLERANCE INTERVALS WITH PROBABILITY LEVEL (CONFIDENCE FACTOR) Y = 0.95 AND COVERAGE P = 95%

| n | K |
|---|---|
| 3 | 7.655 |
| 4 | 5.145 |
| 5 | 4.202 |
| 6 | 3.707 |
| 7 | 3.399 |
| 8 | 3.188 |
| 9 | 3.031 |
| 10 | 2.911 |
| 11 | 2.815 |
| 12 | 2.736 |
| 13 | 2.670 |
| 14 | 2.614 |
| 15 | 2.566 |
| 16 | 2.523 |
| 17 | 2.486 |
| 18 | 2.543 |
| 19 | 2.423 |
| 20 | 2.396 |
| 21 | 2.371 |
| 22 | 2.350 |
| 23 | 2.329 |
| 24 | 2.309 |
| 25 | 2.292 |
| 30 | 2.220 |
| 35 | 2.166 |
| 40 | 2.126 |
| 45 | 2.092 |
| 50 | 2.065 |

| n | K |
|---|---|
| 75 | 1.972 |
| 100 | 1.924 |
| 125 | 1.891 |
| 150 | 1.868 |
| 175 | 1.850 |
| 200 | 1.836 |
| 225 | 1.824 |
| 250 | 1.814 |
| 275 | 1.806 |
| 300 | 1.799 |
| 325 | 1.792 |
| 350 | 1.787 |
| 375 | 1.782 |
| 400 | 1.777 |
| 425 | 1.773 |
| 450 | 1.769 |
| 475 | 1.766 |
| 500 | 1.763 |
| 525 | 1.760 |
| 550 | 1.757 |
| 575 | 1.754 |
| 600 | 1.752 |
| 625 | 1.750 |
| 650 | 1.748 |
| 675 | 1.746 |
| 700 | 1.744 |
| 725 | 1.742 |
| 750 | 1.740 |
| 775 | 1.739 |
| 800 | 1.737 |
| 825 | 0.735 |
| 850 | 1.734 |
| 875 | 1.733 |
| 900 | 1.732 |
| 925 | 1.731 |
| 950 | 1.729 |
| 975 | 1.728 |
| 1000 | 1.727 |

Attachment 5

# Cumulative Binomial Distribution Function for Sample Sizes of 19 and 20

| $n$ | $y$ | $p$ = .50 | .55 | .60 | .65 | .70 | .75 | .80 | .85 | .90 | .95 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 0 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |
| | 1 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |
| | 2 | .0004 | .0001 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |
| | 3 | .0022 | .0005 | .0001 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |
| | 4 | .0096 | .0028 | .0006 | .0001 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |
| | 5 | .0318 | .0109 | .0031 | .0007 | .0001 | .0000 | .0000 | .0000 | .0000 | .0000 |
| | 6 | .0835 | .0342 | .0116 | .0031 | .0006 | .0001 | .0000 | .0000 | .0000 | .0000 |
| | 7 | .1796 | .0871 | .0352 | .0114 | .0028 | .0005 | .0000 | .0000 | .0000 | .0000 |
| | 8 | .3238 | .1841 | .0885 | .0347 | .0105 | .0023 | .0003 | .0000 | .0000 | .0000 |
| | 9 | .5000 | .3290 | .1861 | .0875 | .0326 | .0089 | .0016 | .0001 | .0000 | .0000 |
| | 10 | .6762 | .5060 | .3325 | .1855 | .0839 | .0287 | .0067 | .0008 | .0000 | .0000 |
| | 11 | .8204 | .6831 | .5122 | .3344 | .1820 | .0775 | .0233 | .0041 | .0003 | .0000 |
| | 12 | .9165 | .8273 | .6919 | .5188 | .3345 | .1749 | .0676 | .0163 | .0017 | .0000 |
| | 13 | .9682 | .9223 | .8371 | .7032 | .5261 | .3322 | .1631 | .0537 | .0086 | .0002 |
| | 14 | .9904 | .9720 | .9304 | .8500 | .7178 | .5346 | .3267 | .1444 | .0352 | .0020 |
| | 15 | .9978 | .9923 | .9770 | .9409 | .8668 | .7369 | .5449 | .3159 | .1150 | .0132 |
| | 16 | .9996 | .9985 | .9945 | .9830 | .9538 | .8887 | .7631 | .5587 | .2946 | .0665 |
| | 17 | 1.0000 | .9998 | .9992 | .9969 | .9896 | .9690 | .9171 | .8015 | .5797 | .2453 |
| | 18 | 1.0000 | 1.0000 | .9999 | .9997 | .9989 | .9958 | .9856 | .9544 | .8649 | .6226 |
| | 19 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 20 | 0 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |
| | 1 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |
| | 2 | .0002 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |
| | 3 | .0013 | .0003 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |
| | 4 | .0059 | .0015 | .0003 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |
| | 5 | .0207 | .0064 | .0016 | .0003 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |
| | 6 | .0577 | .0214 | .0065 | .0015 | .0003 | .0000 | .0000 | .0000 | .0000 | .0000 |
| | 7 | .1316 | .0580 | .0210 | .0060 | .0013 | .0002 | .0000 | .0000 | .0000 | .0000 |
| | 8 | .2517 | .1308 | .0565 | .0196 | .0051 | .0009 | .0001 | .0000 | .0000 | .0000 |
| | 9 | .4119 | .2493 | .1275 | .0532 | .0171 | .0039 | .0006 | .0000 | .0000 | .0000 |
| | 10 | .5881 | .4086 | .2447 | .1218 | .0480 | .0139 | .0026 | .0002 | .0000 | .0000 |
| | 11 | .7483 | .5857 | .4044 | .2376 | .1133 | .0409 | .0100 | .0013 | .0001 | .0000 |
| | 12 | .8684 | .7480 | .5841 | .3990 | .2277 | .1018 | .0321 | .0059 | .0004 | .0000 |
| | 13 | .9423 | .8701 | .7500 | .5834 | .3920 | .2142 | .0867 | .0219 | .0024 | .0000 |
| | 14 | .9793 | .9447 | .8744 | .7546 | .5836 | .3828 | .1958 | .0673 | .0113 | .0003 |
| | 15 | .9941 | .9811 | .9490 | .8818 | .7625 | .5852 | .3704 | .1702 | .0432 | .0026 |
| | 16 | .9987 | .9951 | .9840 | .9556 | .8929 | .7748 | .5886 | .3523 | .1330 | .0159 |
| | 17 | .9998 | .9991 | .9964 | .9879 | .9645 | .9087 | .7939 | .5951 | .3231 | .0755 |
| | 18 | 1.0000 | .9999 | .9995 | .9979 | .9924 | .9757 | .9308 | .8244 | .6083 | .2642 |
| | 19 | 1.0000 | 1.0000 | 1.0000 | .9998 | .9992 | .9968 | .9885 | .9612 | .8784 | .6415 |
| | 20 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

For $n$ larger than 20, the $r$th quantile $y_r$ of a binomial random variable may be approximated using $y_r = np + w_r\sqrt{np(1-p)}$, where $w_r$ is the $r$th quantile of a standard normal random variable, obtained from Table A1.

ADAPTED FROM CONOVER (1980)

Attachment 6

# Tests for Distributional Fit

KOLMOGOROV-SMIRNOV ONE SAMPLE TEST USING STANDARD NORMAL DISTRIBUTION

| VARIABLE | N-OF-CASES | MAXDIF | LILLIEFORS PROBABILITY (2-TAIL) |
|---|---|---|---|
| FE | 19.000 | 0.284 | 0.000 |
| MN | 19.000 | 0.142 | 0.403 |
| LNFE | 19.000 | 0.176 | 0.123 |
| LNMN | 19.000 | 0.194 | 0.058 |

KOLMOGOROV-SMIRNOV ONE SAMPLE TEST USING STANDARD NORMAL DISTRIBUTION

| VARIABLE | N-OF-CASES | MAXDIF | LILLIEFORS PROBABILITY (2-TAIL) |
|---|---|---|---|
| FE | 19.000 | 0.508 | 0.000 |
| MN | 19.000 | 0.451 | 0.000 |
| LNFE | 19.000 | 0.376 | 0.000 |
| LNMN | 19.000 | 0.241 | 0.005 |

KOLMOGOROV-SMIRNOV ONE SAMPLE TEST USING STANDARD NORMAL DISTRIBUTION

| VARIABLE | N-OF-CASES | MAXDIF | LILLIEFORS PROBABILITY (2-TAIL) |
|---|---|---|---|
| MN | 19.000 | 0.323 | 0.000 |
| TDS | 19.000 | 0.200 | 0.043 |
| LNMN | 19.000 | 0.303 | 0.000 |
| LNTDS | 19.000 | 0.115 | 0.797 |

OLMOGOROV-SMIRNOV ONE SAMPLE TEST USING STANDARD NORMAL DISTRIBUTION

| VARIABLE | N-OF-CASES | MAXDIF | LILLIEFORS PROBABILITY (2-TAIL) |
|---|---|---|---|
| FE | 27.000 | 0.460 | 0.000 |
| LNFE | 27.000 | 0.271 | 0.000 |

KOLMOGOROV-SMIRNOV ONE SAMPLE TEST USING STANDARD NORMAL DISTRIBUTION

| VARIABLE | N-OF-CASES | MAXDIF | LILLIEFORS PROBABILITY (2-TAIL) |
|---|---|---|---|
| FE | 27.000 | 0.164 | 0.060 |
| LNFE | 27.000 | 0.201 | 0.007 |

KOLMOGOROV-SMIRNOV ONE SAMPLE TEST USING STANDARD NORMAL DISTRIBUTION

| VARIABLE | N-OF-CASES | MAXDIF | LILLIEFORS PROBABILITY (2-TAIL) |
|---|---|---|---|
| FE | 27.000 | 0.122 | 0.367 |
| MN | 19.000 | 0.217 | 0.019 |
| TDS | 19.000 | 0.202 | 0.041 |
| LNFE | 27.000 | 0.256 | 0.000 |
| LNMN | 19.000 | 0.143 | 0.389 |
| LNTDS | 19.000 | 0.313 | 0.000 |

MW-1005S

KOLMOGOROV-SMIRNOV ONE SAMPLE TEST USING STANDARD NORMAL DISTRIBUTION

| VARIABLE | N-OF-CASES | MAXDIF | LILLIEFORS PROBABILITY (2-TAIL) |
|---|---|---|---|
| FE | 27.000 | 0.121 | 0.334 |
| MN | 19.000 | 0.174 | 0.133 |
| LNFE | 27.000 | 0.171 | 0.043 |
| LNMN | 19.000 | 0.178 | 0.115 |

MW-1005P

KOLMOGOROV-SMIRNOV ONE SAMPLE TEST USING STANDARD NORMAL DISTRIBUTION

| VARIABLE | N-OF-CASES | MAXDIF | LILLIEFORS PROBABILITY (2-TAIL) |
|---|---|---|---|
| FE | 27.000 | 0.240 | 0.000 |
| MN | 19.000 | 0.173 | 0.139 |
| LNFE | 27.000 | 0.168 | 0.050 |
| LNMN | 19.000 | 0.171 | 0.154 |

MW-1010P

KOLMOGOROV-SMIRNOV ONE SAMPLE TEST USING STANDARD NORMAL DISTRIBUTION

| VARIABLE | N-OF-CASES | MAXDIF | LILLIEFORS PROBABILITY (2-TAIL) |
|---|---|---|---|
| AS | 7.000 | 0.227 | 0.397 |
| MN | 7.000 | 0.204 | 0.639 |
| LNAS | 7.000 | 0.185 | 0.882 |
| LNMN | 7.000 | 0.227 | 0.396 |

# Exhibit III

## Data and Calculations for Alternative Concentration Limits For Groundwater Monitoring Well MW-1000R

# Foth & Van Dyke
# Memorandum

September 28, 1993

TO: Jerry Sevick

FR: Steve Lehrke *SL*

RE: Completion of Alternative Concentration Limits for Flambeau Mining Company Groundwater Monitoring Wells

Since my June 2, 1993 memorandum was prepared regarding the above topic, background monitoring results for MW-1000R have been received by Foth & Van Dyke. I have summarized the MW-1000R results for iron, manganese and total dissolved solids in the same manner that I summarized results for the other on-site groundwater monitoring wells in Attachment 1 of my June 2, 1993 memo. The MW-1000R summary is included in Attachment A for your information.

A review of the attachment shows that background monitoring at MW-1000R covered the period of November 1992, which was when the well was installed, to June 1993. No further background testing of this well is expected, since it has been dewatered. Dewatering was expected since the well is located adjacent to the project's open pit mine. A review of MW-1000R and MW-1000 monitoring results indicates a reasonably close comparison.

A second comparison of the MW-1000R data to the proposed iron and manganese standards (Attachment B) for the site indicates that an alternate concentration limit for manganese applies to this well.

[AS3S10/32-22191F6

Attachment A

## Iron, Manganese and TDS Background Groundwater Monitoring Data for Groundwater Monitoring Well MW-1000R

Summary Statistics of Iron
Manganese and TDS

Flambeau Mining Co.

| Well ID | DATE | Units | Fe | Mn | TDS |
|---|---|---|---|---|---|
| MW-1000R | Nov-92 | mg/l | <0.055 | 0.14 | 96 |
| MW-1000R | Jan-93 | mg/l | 0.73 | 0.13 | 62 |
| MW-1000R | Feb-93 | mg/l | <0.055 | 0.013 | 85 |
| MW-1000R | Mar-93 | mg/l | <0.055 | 0.018 | 96 |
| MW-1000R | Apr-93 | mg/l | <0.055 | 0.012 | 130 |
| MW-1000R | May-93 | mg/l | <0.055 | 0.014 | 90 |
| MW-1000R | Jun-93 | mg/l | <0.055 | 0.034 | 60 |
| Total Samples | | | 7 | 7 | 7 |
| Total Detects | | | 1 | 7 | 7 |
| Minimum | | | <0.055 | 0.012 | 60 |
| Maximum | | | 0.73 | 0.14 | 130 |
| Mean* | | | 0.128 | 0.052 | 88.4 |

* If Value is Less Than Detection Limit, 1/2 Detection Limit Used to Calculate Mean

# Attachment B

## Summary Statistics and Upper Tolerance Limits for Groundwater Monitoring Well MW-1000R

Summary Statistics and
Upper Tolerance Limits

Flambeau Mining Co.

| Well ID | DATE | Units | Fe | Mn | TDS |
|---|---|---|---|---|---|
| MW-1000R | Nov-92 | mg/l | N.I. | 0.14 | N.I. |
| MW-1000R | Jan-93 | mg/l | N.I. | 0.13 | N.I. |
| MW-1000R | Feb-93 | mg/l | N.I. | 0.013 | N.I. |
| MW-1000R | Mar-93 | mg/l | N.I. | 0.018 | N.I. |
| MW-1000R | Apr-93 | mg/l | N.I. | 0.012 | N.I. |
| MW-1000R | May-93 | mg/l | N.I. | 0.014 | N.I. |
| MW-1000R | Jun-93 | mg/l | N.I. | 0.034 | N.I. |
| Total Samples | | | N.I. | 7 | N.I. |
| Number of Detections | | | N.I. | 7 | N.I. |
| Upper Tolerance Limit | | | N.I. | 1.17(2) | N.I. |
| Current Site MCL | | | N.I. | 0.090 | N.I. |

- No Sample Collected

* Upper Tolerance Limit is Equal to Upper 95th Confidence Limit on 95th Percentile (Proposed Alternate Concentration Limit)

N.I. - Values Not Included; No Alternate Concentration Limit Proposed

(1) Calculated Assuming Normal Distribution

(2) Calculated Assuming Log-Normal Distribution

(3) Calculated With Nonparametric Methods (No Distributional Assumptions)

# Exhibit IV

## Comparison of October 1987 Through April 1991 to July 1991 Through October 1992 Flambeau Groundwater Quality Data

# Foth & Van Dyke
# Memorandum

June 2, 1993

TO: Jerry Sevick

FR: Steve Lehrke SL

RE: Comparison of October 1987 Through April 1991 to July 1991 Through October 1992 Flambeau Groundwater Quality Data

## Introduction

Groundwater quality data for several parameters, including iron, manganese and TDS, have been collected by the Flambeau Mining Company since October of 1987. Groundwater samples for iron, manganese, TDS and other parameters were collected and analyzed monthly from October of 1987 through September of 1988. In addition, samples were collected and analyzed quarterly for iron from April of 1989 through April of 1991. Following commencement of surface facilities construction in July 1991, iron, manganese and TDS samples have been collected quarterly. The analytical results for these three compounds through the October 1992 monitoring quarter are illustrated in Table 1.

A statistical analysis of the three compounds was completed to determine if the concentrations observed before surface facility construction commenced differed significantly from those observed after this time. The statistical methods used and the results of the analysis are presented in this memo.

## Statistical Methods

Three types of statistical tests were used to determine whether significant differences exist for a given monitoring well between the October 1987 through April 1991 data and the July 1991 through October 1992 data. These tests were the two-sample t-test, the rank sum test, and the test of proportions. The test which was used was determined by the characteristics of the data. The decision process of choosing the statistical test is illustrated in Attachment 1. All tests were performed at the 0.05 critical level. This refers to a five percent chance of declaring a significant difference between two data sets when none exists.

The two-sample t-test compares the difference between the means of two samples. If the difference between the means of each sample is large compared to the variation within each sample, they are declared to be significantly different. The two-sample t-test assumes the two data sets are normally distributed and have the same amount of variation.

If the assumptions of normality or equal variance of the data were not met, the rank sum test was used. This is a non-parametric test which does not rely on these assumptions. In this test, the data of both samples are ordered and ranked. The mean and variance of the ranks are then used, instead of the original data, to test for significant differences.

If the number of non-detections was high in the two samples, the test of proportions was used. In this test, the data is classified as either positive (above detection) or negative (below detection). The percentage of positive results in the two samples are then tested to determine if a significant difference exists.

The sample size, number of detections, coefficient of variation, mean and standard deviation of each data set are given in Table 2 for the October 1987 through April 1991 data, and in Table 3 for the July 1991 through October 1992 data. If the data were normally distributed (determined by a coefficient of variation less than 1.0), the two data sets were tested for common variance by the F-test. The results of the F-test are given in Table 4. The value of the F-statistic is found by dividing the variance of one data set by the variance of the other data set. This value is then compared to the upper 0.05 critical value of the F-distribution given as F(.05).

If the calculated value was greater than the critical value in Table 4, it was concluded that the two data sets had unequal variances, and the rank sum test was used. If the calculated value was less than the critical value it was concluded that the two data sets had equal variances, and the two-sample t-test was used. In the two-sample t-test, values below the detection limit were replaced with a value of zero. The statistical tests chosen for each of the monitoring wells are summarized in Table 5.

If either of the two data sets being tested consisted of greater than 90 percent nondetects, no statistical test was performed due to lack of variation in the data. As can be seen in Table 5, this is the case for iron in MW 1002, MW 1002G and MW 1004S, and manganese in MW 1004S. Between October of 1987 and October of 1992, iron was detected only once in MW 1002, not at all in MW 1002G, and only twice in MW 1004S. Between January of 1988 and October of 1992, manganese in MW 1004S was not detected at all.

## Conclusions

A graph of historical groundwater concentrations is provided in Attachment 2 for all wells in which the statistical tests indicated a significant difference exists between the October 1987 through April 1991 data and the July 1991 through October 1992 data. No significant difference was found in the TDS concentrations in any of the groundwater monitoring wells before or after construction of surface facilities commenced.

The only monitoring wells revealing a significant difference in iron concentrations between the October 1987 through April 1991 and July 1991 through October 1992 data sets were MW1000P, MW1004P, MW1005 and MW1005P.

As can be seen in the graphs, in Attachment 2, current levels of iron appear to be higher than those observed in 1987 and 1988. However, in the graphs of MW1004P, MW1005 and MW1005P it is evident that the increase in iron levels already took place in 1989, well before surface facility construction commenced. Although data was not collected in 1989 and 1990 for MW1000P, it is probable that it followed a similar pattern of iron concentrations, increasing before surface facility construction commenced.

Further support for this conclusion is found in the trend analysis of the data collected after surface facility construction commenced (July 1991 through October 1992) included in the 1992 Flambeau Mining Company Annual Report (January 1993). In this analysis, no significant trend, either increasing or decreasing, was found in iron concentrations in any groundwater monitoring wells.

Manganese was also significantly higher in MW1000P in the period of July 1991 through October 1992. However, similar to iron concentrations in MW1000P, no trend was observed in the July 1991 to October 1992 data. In addition, the graph of manganese in MW1000P (Attachment 2) reveals concentrations to be increasing already in 1988. Therefore, similar to iron, manganese concentrations may be significantly higher than those observed in 1987 and 1988, but not significantly higher than those observed in 1989 and 1990.

A significant decrease of manganese has occurred in MW1005 and MW1005S and MW1005P in the period of July 1991 through October 1992. Graphs of manganese concentrations in these three monitoring wells are provided in Attachment 2. No significant difference was found in manganese concentrations before or after the mine was constructed in any other monitoring well.

Based on the analysis addressed in this memorandum, it can be concluded that no significant difference in groundwater quality data for iron, manganese and TDS exists when comparing data collected between 1989 and 1992. Some significant concentration differences were noted in the 1987 and 1988 data, however, the cause of this would not be due to the start of surface facility construction at the site, since this occurred in 1991.

SGL:naj:jef

Attachments

Table 1

Flambeau Mining Co.
Groundwater Quality Data

| Compound | Units | Oct 87 | Nov 87 | Dec 87 | Jan 88 | Feb 88 | Mar 88 | Apr 88 | May 88 | Jun 88 | Jul 88 | Aug 88 | Sep 88 | Apr 89 | Jul 89 | Nov 89 | Jan 90 | Apr 90 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW1000 | | | | | | | | | | | | | | | | | | |
| Iron | mg/l | 0.11 | <0.10 | <0.10 | <0.10 | <0.10 | 0.15 | <0.10 | <0.10 | <0.10 | 0.16 | 0.20 | <0.10 | - | - | - | - | - |
| Manganese | mg/l | 0.09 | 0.10 | 0.11 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | - | - | - | - | - |
| TDS | mg/l | 110 | 250 | 64 | 100 | 67 | 64 | 33 | 120 | 120 | 120 | 100 | 50 | - | - | - | - | - |
| MW1000P | | | | | | | | | | | | | | | | | | |
| Iron | mg/l | 0.12 | 0.15 | 0.11 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.20 | 0.11 | 0.45 | - | - | - | - | - |
| Manganese | mg/l | 0.26 | 0.46 | 0.59 | 0.55 | 0.61 | 0.65 | 0.64 | 0.59 | 0.70 | 0.72 | 0.75 | 0.73 | - | - | - | - | - |
| TDS | mg/l | 290 | 350 | 160 | 210 | 150 | 140 | 130 | 200 | 200 | 180 | 160 | 130 | - | - | - | - | - |
| MW1002 | | | | | | | | | | | | | | | | | | |
| Iron | mg/l | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.06 | <0.10 | - | - | - | - | - |
| Manganese | mg/l | 0.20 | 0.21 | 0.15 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | - | - | - | - | - |
| TDS | mg/l | 200 | 200 | 140 | 160 | 110 | 100 | 34 | 170 | 150 | 140 | 130 | 100 | - | - | - | - | - |
| MW1002G | | | | | | | | | | | | | | | | | | |
| Iron | mg/l | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.06 | <0.10 | - | - | - | - | - |
| Manganese | mg/l | 0.09 | 0.12 | 0.09 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | - | - | - | - | - |
| TDS | mg/l | 200 | 250 | 170 | 170 | 170 | 140 | 88 | 220 | 220 | 190 | 200 | 140 | - | - | - | - | - |
| MW1004 | | | | | | | | | | | | | | | | | | |
| Iron | mg/l | 0.21 | 0.26 | 0.12 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.12 | <0.06 | <0.10 | <0.055 | 0.097 | 0.055 | <0.026 | 0.077 |
| Manganese | mg/l | <0.05 | 0.28 | 0.07 | <0.05 | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.06 | - | - | - | - | - |
| TDS | mg/l | 570 | 400 | 800 | 280 | 220 | 240 | 31 | 360 | 130 | 130 | 120 | 77 | - | - | - | - | - |
| MW1004S | | | | | | | | | | | | | | | | | | |
| Iron | mg/l | 0.11 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.06 | <0.10 | <0.055 | <0.055 | <0.023 | <0.026 | <0.055 |
| Manganese | mg/l | 0.11 | 0.09 | 0.07 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | - | - | - | - | - |
| TDS | mg/l | 120 | 180 | 120 | 130 | 99 | 100 | 14 | 150 | 160 | 150 | 130 | 91 | - | - | - | - | - |
| MW1004P | | | | | | | | | | | | | | | | | | |
| Iron | mg/l | <0.10 | <0.10 | <0.10 | 0.10 | 0.55 | <0.10 | 0.14 | <0.10 | <0.10 | 0.19 | <0.06 | <0.10 | 0.26 | 0.63 | 0.25 | 0.33 | 0.2 |
| Manganese | mg/l | 0.12 | 0.13 | 0.14 | 0.14 | 0.21 | <0.12 | 0.14 | 0.13 | 0.12 | 0.13 | 0.12 | 0.11 | - | - | - | - | - |
| TDS | mg/l | 180 | 220 | 200 | 200 | 190 | 180 | 120 | 230 | 240 | 220 | 220 | 170 | - | - | - | - | - |
| MW1005 | | | | | | | | | | | | | | | | | | |
| Iron | mg/l | 7.20 | 6.10 | 13.00 | 12.00 | 12.00 | 7.90 | 3.50 | 15.00 | 21.00 | 19.00 | 1.10 | 12.00 | 12 | 7.8 | 18 | 20 | 16 |
| Manganese | mg/l | 1.40 | 1.10 | 0.75 | 0.65 | 0.75 | 0.71 | 0.63 | 0.56 | 0.62 | 0.64 | 0.45 | 0.56 | - | - | - | - | - |
| TDS | mg/l | 640 | 610 | 650 | 640 | 550 | 630 | 580 | 730 | 770 | 650 | 1000 | 690 | - | - | - | - | - |
| MW1005S | | | | | | | | | | | | | | | | | | |
| Iron | mg/l | 4.00 | 3.10 | 4.00 | 3.00 | 3.10 | 2.60 | 4.30 | 2.10 | 1.90 | 4.00 | 3.40 | 3.10 | 3.2 | 3.8 | 3.3 | 3.4 | 2.9 |
| Manganese | mg/l | 0.23 | 0.28 | 0.29 | 0.25 | 0.29 | 0.26 | 0.26 | 0.28 | 0.26 | 0.24 | 0.27 | 0.27 | - | - | - | - | - |
| TDS | mg/l | 204 | 300 | 210 | 220 | 220 | 230 | 220 | 260 | 270 | 270 | 220 | 220 | - | - | - | - | - |
| MW1005P | | | | | | | | | | | | | | | | | | |
| Iron | mg/l | 0.38 | 0.56 | 0.18 | 0.20 | 0.22 | 0.29 | 0.54 | 0.72 | 0.27 | 0.63 | 0.95 | <0.10 | 0.26 | 1.1 | 1 | 0.98 | 0.7 |
| Manganese | mg/l | 0.15 | 0.24 | 0.13 | 0.25 | 0.25 | 0.20 | 0.25 | 0.26 | 0.22 | 0.25 | 0.18 | 0.15 | - | - | - | - | - |
| TDS | mg/l | 270 | 330 | 290 | 280 | 280 | 280 | 230 | 300 | 320 | 310 | 290 | 250 | - | - | - | - | - |

## Table 1 (Cont'd.)

Flambeau Mining Co.
Groundwater Quality Data

| Compound | Units | Aug 90 | Oct 90 | Apr 91 | Jul 91 | Oct 91 | Jan 92 | Apr 92 | Jul 92 | Oct 92 |
|---|---|---|---|---|---|---|---|---|---|---|
| MW1000 | | | | | | | | | | |
| Iron | mg/l | - | - | - | <0.055 | <0.055 | <0.055 | 0.25 | <0.055 | <0.055 |
| Manganese | mg/l | - | - | - | <0.004 | 0.004 | 0.0061 | 0.0071 | 0.0056 | <0.004 |
| TDS | mg/l | - | - | - | 160 | 180 | 110 | 130 | 120 | <50 |
| MW1000P | | | | | | | | | | |
| Iron | mg/l | - | - | - | 0.65 | 0.84 | 1.7 | 1.3 | 0.47 | 0.8 |
| Manganese | mg/l | - | - | - | 0.85 | 0.88 | 0.82 | 0.83 | 0.73 | 0.78 |
| TDS | mg/l | - | - | - | 190 | 160 | 120 | 120 | 140 | 160 |
| MW1002 | | | | | | | | | | |
| Iron | mg/l | - | - | - | 0.99 | <0.055 | <0.055 | <0.055 | <0.055 | <0.055 |
| Manganese | mg/l | - | - | - | 0.0051 | <0.004 | <0.004 | <0.004 | <0.004 | 0.015 |
| TDS | mg/l | - | - | - | 160 | 170 | 100 | 85 | 87 | 130 |
| MW1002G | | | | | | | | | | |
| Iron | mg/l | - | - | - | <0.055 | <0.055 | <0.055 | <0.055 | <0.055 | <0.055 |
| Manganese | mg/l | - | - | - | 0.0054 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 |
| TDS | mg/l | - | - | - | 240 | 280 | 140 | 150 | 150 | 180 |
| MW1004 | | | | | | | | | | |
| Iron | mg/l | <0.055 | <0.055 | 0.11 | <0.055 | <0.055 | <0.055 | <0.055 | 0.059 | <0.055 |
| Manganese | mg/l | - | - | - | 0.0044 | <0.004 | <0.004 | <0.004 | 0.057 | <0.004 |
| TDS | mg/l | - | - | - | 190 | 150 | 65 | 82 | 77 | 48 |
| MW1004S | | | | | | | | | | |
| Iron | mg/l | <0.055 | 0.66 | <0.055 | <0.055 | <0.055 | <0.055 | <0.055 | <0.055 | <0.055 |
| Manganese | mg/l | - | - | - | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 |
| TDS | mg/l | - | - | - | 160 | 170 | 95 | 100 | 110 | 220 |
| MW1004P | | | | | | | | | | |
| Iron | mg/l | 0.31 | 0.22 | 0.32 | 0.33 | 0.22 | 0.32 | 0.37 | 0.38 | 0.32 |
| Manganese | mg/l | - | - | - | 0.13 | 0.13 | 0.12 | 0.14 | 0.13 | 0.13 |
| TDS | mg/l | - | - | - | 210 | 310 | 160 | 180 | 180 | 260 |
| MW1005 | | | | | | | | | | |
| Iron | mg/l | 17 | 14 | 15 | 17 | 20 | 18 | 17 | 19 | 22 |
| Manganese | mg/l | - | - | - | 0.51 | 0.49 | 0.46 | 0.38 | 0.44 | 0.47 |
| TDS | mg/l | - | - | - | 570 | 770 | 530 | 680 | 640 | 600 |
| MW1005S | | | | | | | | | | |
| Iron | mg/l | 1.7 | 2.9 | 3.6 | 3 | 3.8 | 3.6 | 3.7 | 4.1 | 3.9 |
| Manganese | mg/l | - | - | - | 0.21 | 0.22 | 0.21 | 0.2 | 0.21 | 0.2 |
| TDS | mg/l | - | - | - | 220 | 370 | <20 | 210 | 220 | 260 |
| MW1005P | | | | | | | | | | |
| Iron | mg/l | 3.7 | 0.89 | 0.77 | 1.2 | 1 | 0.75 | 1 | 0.95 | 1.2 |
| Manganese | mg/l | - | - | - | 0.22 | 0.15 | 0.16 | 0.13 | 0.15 | 0.1 |
| TDS | mg/l | - | - | - | 290 | 440 | 280 | 350 | 270 | 320 |

## Table 2

### Summary Statistics of the October 1987 Through April 1991 Data

| Dates | Compound | Well | N | Detects | C.V. | $\overline{X}$ | S |
|---|---|---|---|---|---|---|---|
| 87-91 | Iron | MW1000 | 12 | 4 | 1.52 | 0.052 | 0.079 |
| 87-91 | Iron | MW1000P | 12 | 6 | 1.40 | 0.095 | 0.133 |
| 87-91 | Iron | MW1002 | 12 | 0 | -- | 0 | 0 |
| 87-91 | Iron | MW1002G | 12 | 0 | -- | 0 | 0 |
| 87-91 | Iron | MW1004 | 20 | 8 | 1.49 | 0.052 | 0.078 |
| 87-91 | Iron | MW1004S | 20 | 2 | 3.85 | 0.039 | 0.148 |
| 87-91 | Iron | MW1004P | 20 | 12 | 1.08 | 0.175 | 0.189 |
| 87-91 | Iron | MW1005 | 20 | 20 | 0.44 | 12.48 | 5.49 |
| 87-91 | Iron | MW1005S | 20 | 20 | 0.22 | 3.17 | 0.706 |
| 87-91 | Iron | MW1005P | 20 | 19 | 1.08 | 0.717 | 0.773 |
| 10/87-4/91 | Manganese | MW1000 | 12 | 3 | 1.82 | 0.025 | 0.045 |
| 10/87-4/91 | Manganese | MW1000P | 12 | 12 | 0.23 | 0.604 | 0.137 |
| 10/87-4/91 | Manganese | MW1002 | 12 | 3 | 1.83 | 0.047 | 0.086 |
| 10/87-4/91 | Manganese | MW1002G | 12 | 3 | 1.83 | 0.025 | 0.046 |
| 10/87-4/91 | Manganese | MW1004 | 12 | 4 | 2.11 | 0.038 | 0.081 |
| 10/87-4/91 | Manganese | MW1004S | 12 | 3 | 1.85 | 0.023 | 0.042 |
| 10/87-4/91 | Manganese | MW1004P | 12 | 11 | 0.38 | 0.124 | 0.047 |
| 10/87-4/91 | Manganese | MW1005 | 12 | 12 | 0.36 | 0.735 | 0.263 |
| 10/87-4/91 | Manganese | MW1005S | 12 | 12 | 0.07 | 0.265 | 0.019 |
| 10/87-4/91 | Manganese | MW1005P | 12 | 12 | 0.22 | 0.211 | 0.047 |
| 10/87-4/91 | TDS | MW1000 | 12 | 12 | 0.56 | 99.83 | 55.98 |
| 10/87-4/91 | TDS | MW1000P | 12 | 12 | 0.35 | 191.67 | 66.99 |
| 10/87-4/91 | TDS | MW1002 | 12 | 12 | 0.34 | 136.17 | 46.57 |
| 10/87-4/91 | TDS | MW1002G | 12 | 12 | 0.24 | 179.83 | 43.66 |
| 10/87-4/91 | TDS | MW1004 | 12 | 12 | 0.80 | 279.83 | 224.48 |

Table 2 *(Continued)*

| Dates | Compound | Well | N | Detects | C.V. | $\overline{X}$ | S |
|---|---|---|---|---|---|---|---|
| 10/87-4/91 | TDS | MW1004S | 12 | 12 | 0.36 | 120.33 | 42.76 |
| 10/87-4/91 | TDS | MW1004P | 12 | 12 | 0.17 | 197.50 | 32.79 |
| 10/87-4/91 | TDS | MW1005 | 12 | 12 | 0.17 | 678.33 | 117.69 |
| 10/87-4/91 | TDS | MW1005S | 12 | 12 | 0.13 | 237.00 | 30.13 |
| 10/87-4/91 | TDS | MW1005P | 12 | 12 | 0.10 | 285.83 | 28.11 |

Table 3

Summary Statistics of the July 1991
Through October 1992 Data

| Dates | Compound | Well | N | Detects | C.V. | $\overline{X}$ | S |
|---|---|---|---|---|---|---|---|
| 7/91-10/92 | Iron | MW1000 | 6 | 1 | 2.45 | 0.042 | 0.102 |
| 7/91-10/92 | Iron | MW1000P | 6 | 6 | 0.48 | 0.960 | 0.456 |
| 7/91-10/92 | Iron | MW1002 | 6 | 1 | 2.45 | 0.165 | 0.404 |
| 7/91-10/92 | Iron | MW1002G | 6 | 0 | -- | 0 | 0 |
| 7/91-10/92 | Iron | MW1004 | 6 | 1 | 2.45 | 0.010 | 0.024 |
| 7/91-10/92 | Iron | MW1004S | 6 | 0 | -- | 0 | 0 |
| 7/91-10/92 | Iron | MW1004P | 6 | 6 | 0.18 | 0.323 | 0.057 |
| 7/91-10/92 | Iron | MW1005 | 6 | 6 | 0.10 | 18.83 | 1.941 |
| 7/91-10/92 | Iron | MW1005S | 6 | 6 | 0.10 | 3.683 | 0.376 |
| 7/91-10/92 | Iron | MW1005P | 6 | 6 | 0.17 | 1.017 | 0.169 |
| 7/91-10/92 | Manganese | MW1000 | 6 | 4 | 0.82 | 0.004 | 0.003 |
| 7/91-10/92 | Manganese | MW1000P | 6 | 6 | 0.07 | 0.815 | 0.053 |
| 7/91-10/92 | Manganese | MW1002 | 6 | 2 | 1.81 | 0.003 | 0.006 |
| 7/91-10/92 | Manganese | MW1002G | 6 | 1 | 2.45 | 0.001 | 0.002 |
| 7/91-10/92 | Manganese | MW1004 | 6 | 2 | 2.25 | 0.010 | 0.023 |
| 7/91-10/92 | Manganese | MW1004S | 6 | 0 | -- | 0 | 0 |
| 7/91-10/92 | Manganese | MW1004P | 6 | 6 | 0.05 | 0.130 | 0.006 |
| 7/91-10/92 | Manganese | MW1005 | 6 | 6 | 0.10 | 0.458 | 0.045 |
| 7/91-10/92 | Manganese | MW1005S | 6 | 6 | 0.04 | 0.208 | 0.008 |
| 7/91-10/92 | Manganese | MW1005P | 6 | 6 | 0.26 | 0.152 | 0.040 |
| 7/91-10/92 | TDS | MW1000 | 6 | 5 | 0.54 | 116.67 | 62.82 |
| 7/91-10/92 | TDS | MW1000P | 6 | 6 | 0.18 | 148.33 | 27.14 |
| 7/91-10/92 | TDS | MW1002 | 6 | 6 | 0.30 | 122.00 | 37.12 |
| 7/91-10/92 | TDS | MW1002G | 6 | 6 | 0.30 | 190.00 | 57.27 |
| 7/91-10/92 | TDS | MW1004 | 6 | 6 | 0.54 | 102.00 | 55.42 |

Table 3 *(Continued)*

| Dates | Compound | Well | N | Detects | C.V. | $\overline{X}$ | S |
|---|---|---|---|---|---|---|---|
| 7/91-10/92 | TDS | MW1004S | 6 | 6 | 0.35 | 142.50 | 49.37 |
| 7/91-10/92 | TDS | MW1004P | 6 | 6 | 0.27 | 216.67 | 57.50 |
| 7/91-10/92 | TDS | MW1005 | 6 | 6 | 0.14 | 631.67 | 85.65 |
| 7/91-10/92 | TDS | MW1005S | 6 | 5 | 0.56 | 213.33 | 120.27 |
| 7/91-10/92 | TDS | MW1005P | 6 | 6 | 0.20 | 325.00 | 63.48 |

Table 4

F-Test For Common Variance

| Compound | Well | Calculated F* | Degrees of Freedom | F(.05) |
|---|---|---|---|---|
| Iron | MW1000 | -- | | |
| Iron | MW1000P | 11.755 | 5,11 | 3.20 |
| Iron | MW1002 | -- | | |
| Iron | MW1002G | -- | | |
| Iron | MW1004 | -- | | |
| Iron | MW1004S | -- | | |
| Iron | MW1004P | 10.994 | 19,5 | 4.56 |
| Iron | MW1005 | 8.00 | 19,5 | 4.56 |
| Iron | MW1005S | 3.52 | 19,5 | 4.56 |
| Iron | MW1005P | 20.92 | 19,5 | 4.56 |
| Manganese | MW1000 | 225.0 | 11,5 | 4.71 |
| Manganese | MW1000P | 6.682 | 11,5 | 4.71 |
| Manganese | MW1002 | -- | | |
| Manganese | MW1002G | -- | | |
| Manganese | MW1004 | -- | | |
| Manganese | MW1004S | -- | | |
| Manganese | MW1004P | 61.36 | 11,5 | 4.71 |
| Manganese | MW1005 | 34.16 | 11,5 | 4.71 |
| Manganese | MW1005S | 5.641 | 11,5 | 4.71 |
| Manganese | MW1005P | 1.381 | 11,5 | 4.71 |
| TDS | MW1000 | 1.259 | 5,11 | 3.20 |
| TDS | MW1000P | 6.092 | 11,5 | 4.71 |
| TDS | MW1002 | 1.574 | 11,5 | 4.71 |
| TDS | MW1002G | 1.721 | 5,11 | 3.20 |
| TDS | MW1004 | 16.406 | 11,5 | 4.71 |

Table 4 *(Continued)*

| Compound | Well | Calculated F* | Degrees of Freedom | F(.05) |
|---|---|---|---|---|
| TDS | MW1004S | 1.333 | 5,11 | 3.20 |
| TDS | MW1004P | 3.075 | 5,11 | 3.20 |
| TDS | MW1005 | 1.888 | 11,5 | 4.71 |
| TDS | MW1005S | 15.934 | 5,11 | 3.20 |
| TDS | MW1005P | 5.100 | 5,11 | 3.20 |

*Calculated F = Variance of group 1/variance of group 2 or variance of group 2/variance of group 1 whichever is larger.

Table 5

Tests of Significance Chosen

| | | |
|---|---|---|
| Iron | MW1000 | Test of Proportions |
| Iron | MW1000P | Rank Sum Test |
| Iron | MW1002 | -- |
| Iron | MW1002G | -- |
| Iron | MW1004 | Test of Proportions |
| Iron | MW1004S | -- |
| Iron | MW1004P | Rank Sum Test |
| Iron | MW1005 | Rank Sum Test |
| Iron | MW1005S | Two-Sample t-Test |
| Iron | MW1005P | Rank Sum Test |
| Manganese | MW1000 | Rank Sum Test |
| Manganese | MW1000P | Rank Sum Test |
| Manganese | MW1002 | Test of Proportions |
| Manganese | MW1002G | Test of Proportions |
| Manganese | MW1004 | Test of Proportions |
| Manganese | MW1004S | -- |
| Manganese | MW1004P | Rank Sum Test |
| Manganese | MW1005 | Rank Sum Test |
| Manganese | MW1005S | Rank Sum Test |
| Manganese | MW1005P | Two-Sample t-Test |
| TDS | MW1000 | Two-Sample t-Test |
| TDS | MW1000P | Rank Sum Test |
| TDS | MW1002 | Two-Sample t-Test |
| TDS | MW1002G | Two-Sample t-Test |
| TDS | MW1004 | Rank Sum Test |
| TDS | MW1004S | Two-Sample t-Test |
| TDS | MW1004P | Two-Sample t-Test |

Table 5 *(Continued)*

| | | |
|---|---|---|
| TDS | MW1005 | Two-Sample t-Test |
| TDS | MW1005S | Rank Sum Test |
| TDS | MW1005P | Rank Sum Test |

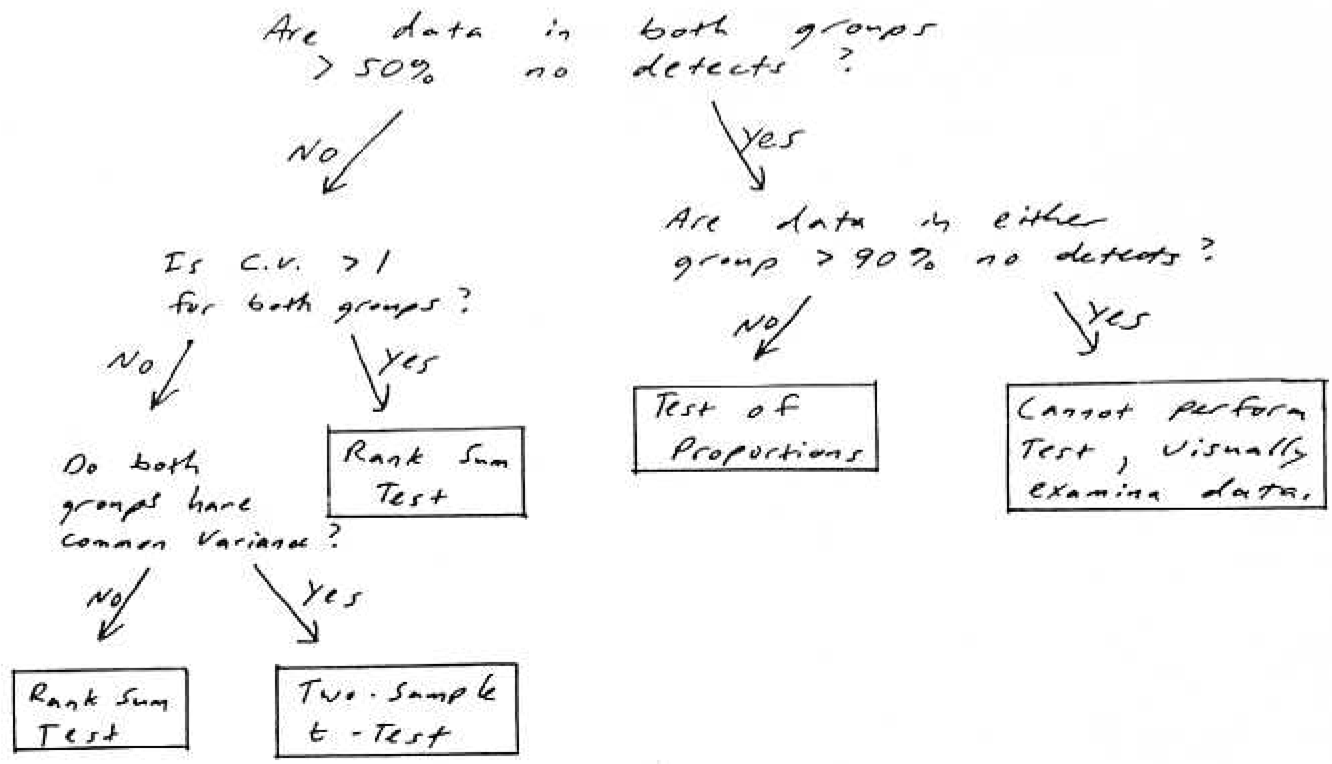
Attachment 1

# Selection Process of Statistical Tests

**Foth & Van Dyke**

Client: Flambeau Mining Co. Scope I.D.: 91FG
Project: Groundwater Analysis Page: 1/1
Prepared by: Steve Lehrke Date: 1-14-93
Checked by: Date:

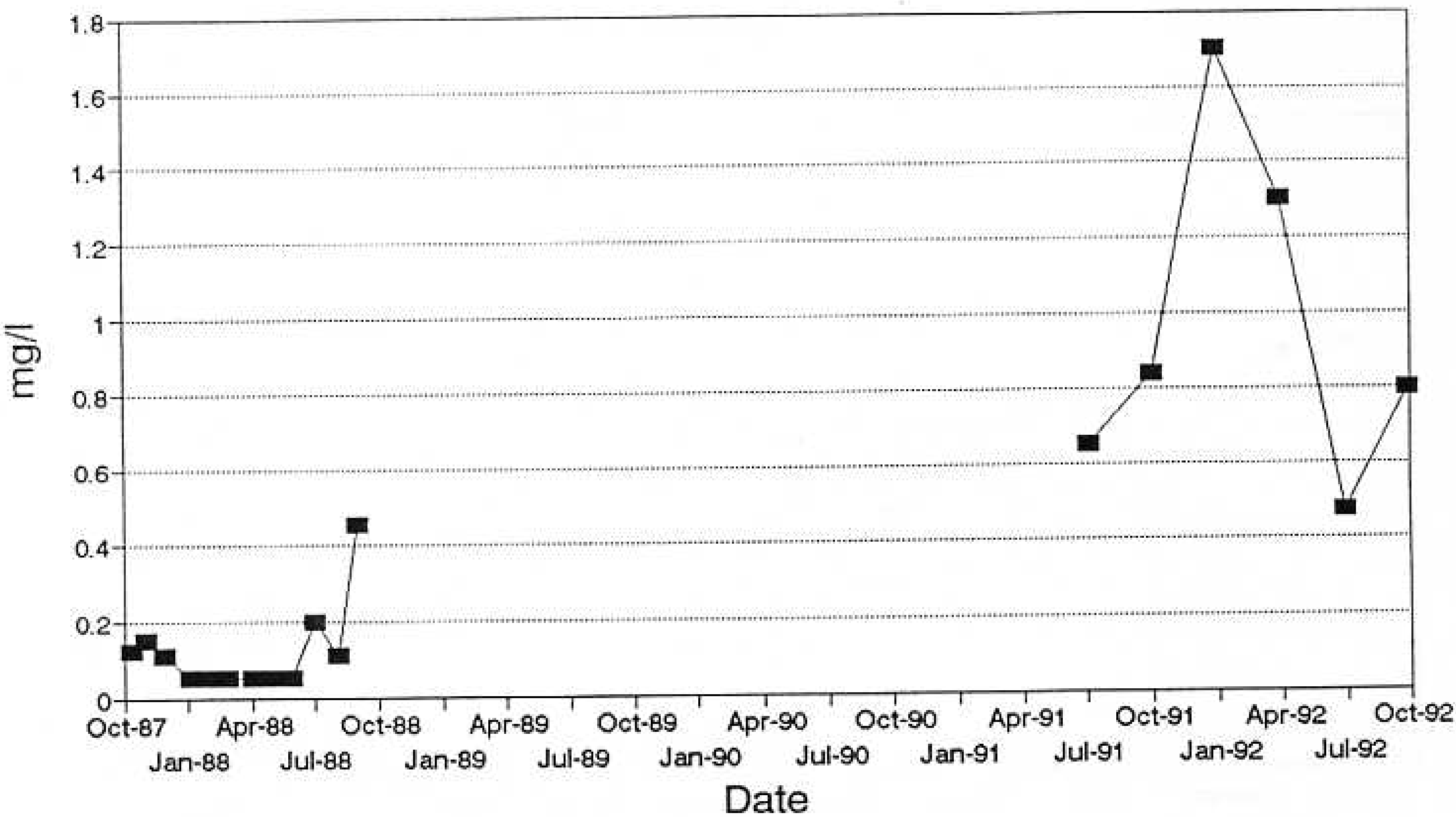
Selection Process of Statistical Tests



# Attachment 2

# Groundwater Quality Graphs

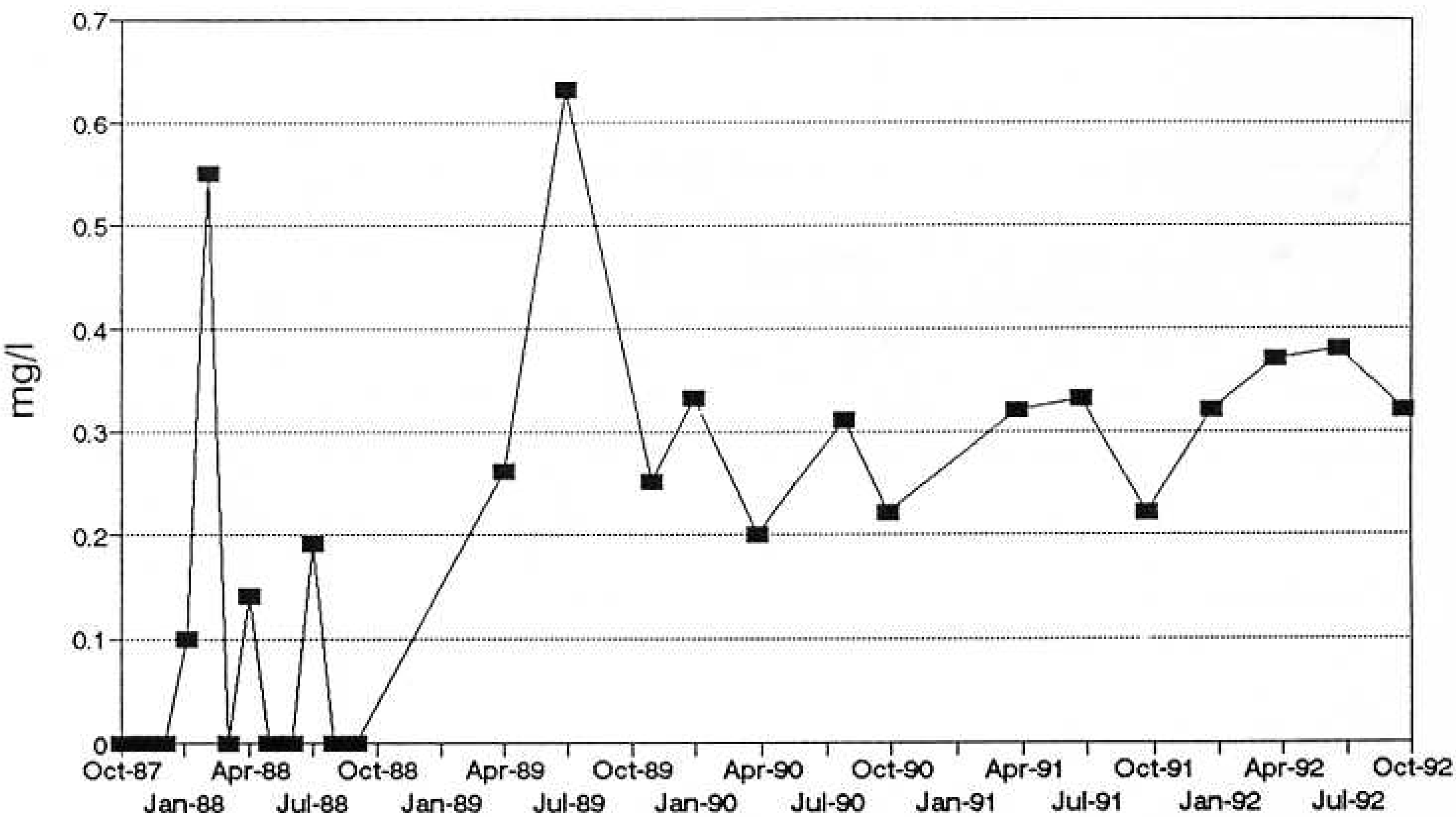
# Groundwater Quality Results
## Iron - MW1000P




Preventative Action Limit (PAL) = 0.15 mg/l

Enforcement Standard (ES) = 0.3 mg/l

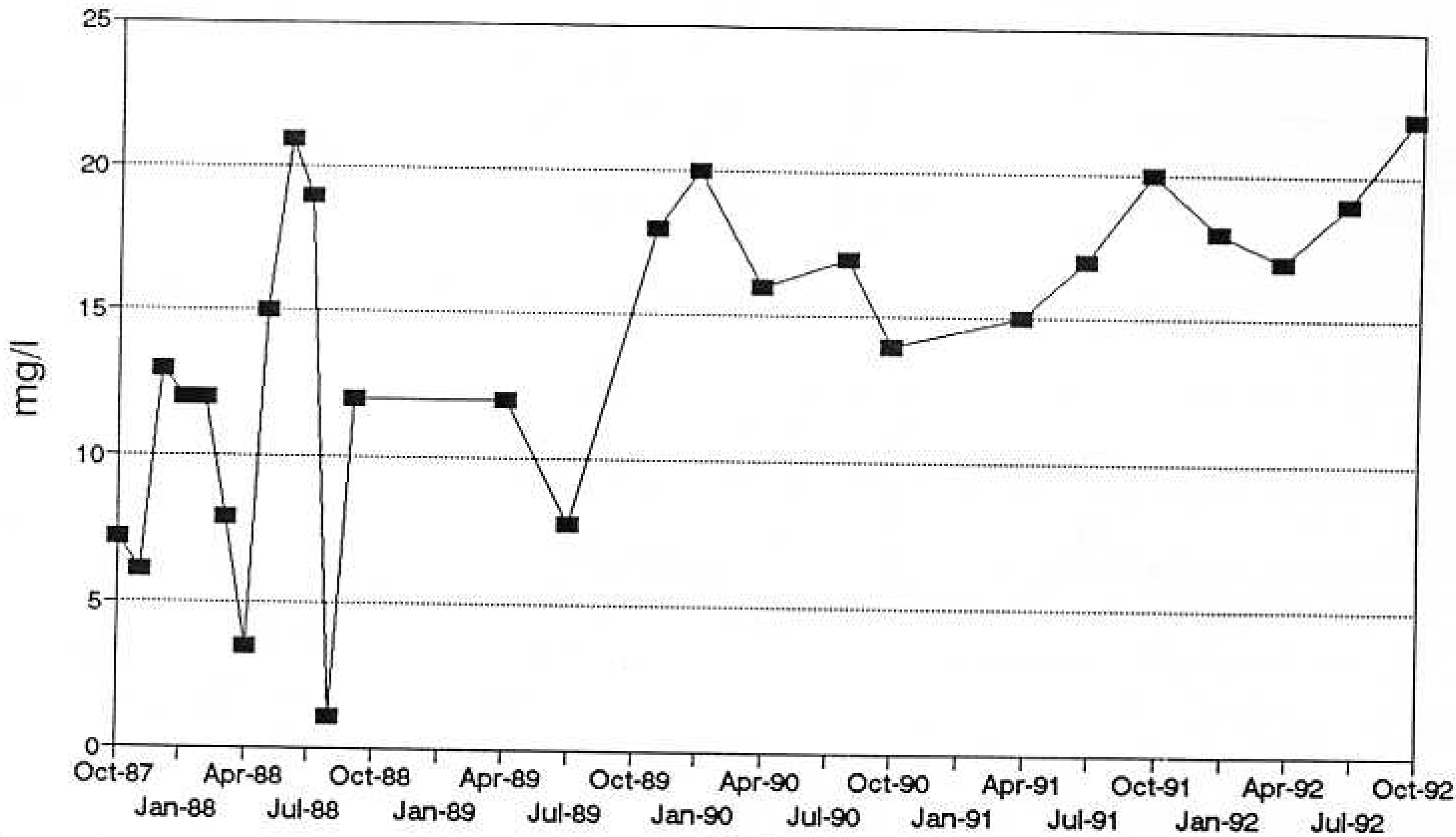
# Groundwater Quality Results
## Iron - MW 1004P




Preventative Action Limit (PAL) = 0.15 mg/l

Enforcement Standard (ES) = 0.3 mg/l

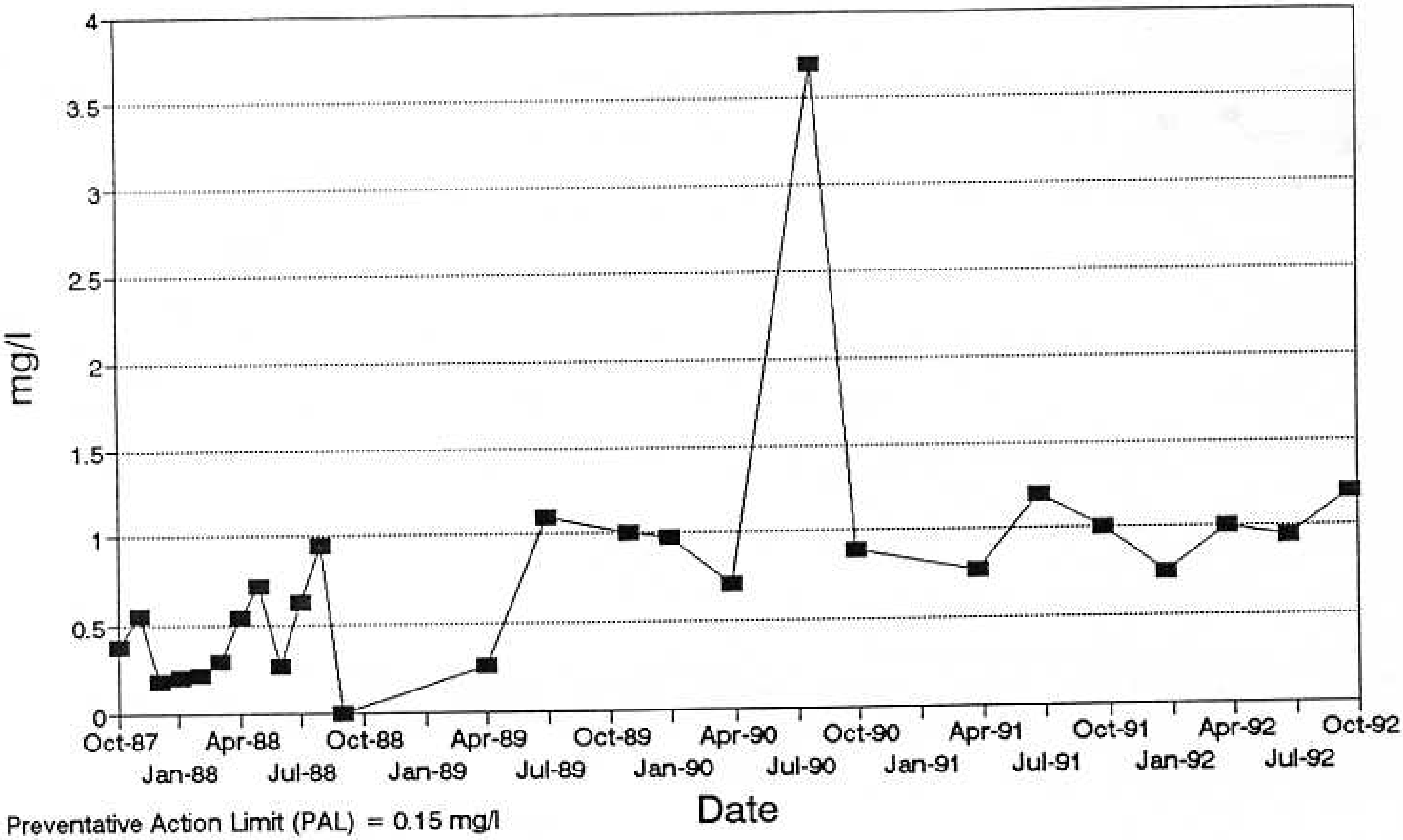
# Groundwater Quality Results
## Iron - MW 1005




Preventative Action Limit (PAL) = 0.15 mg/l

Enforcement Standard (ES) = 0.3 mg/l

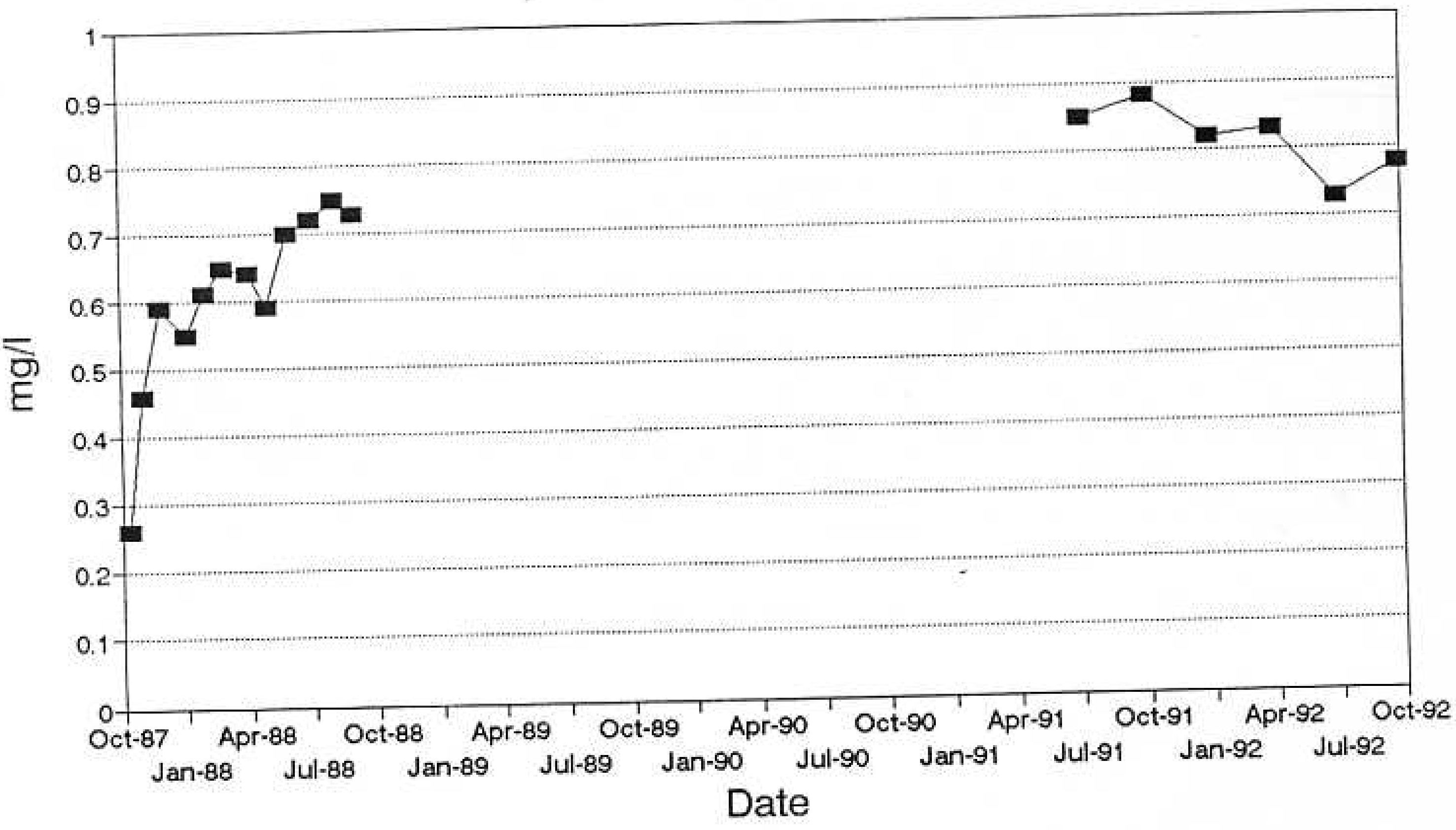
# Groundwater Quality Results
## Iron - MW 1005P




Preventative Action Limit (PAL) = 0.15 mg/l

Enforcement Standard (ES) = 0.3 mg/l

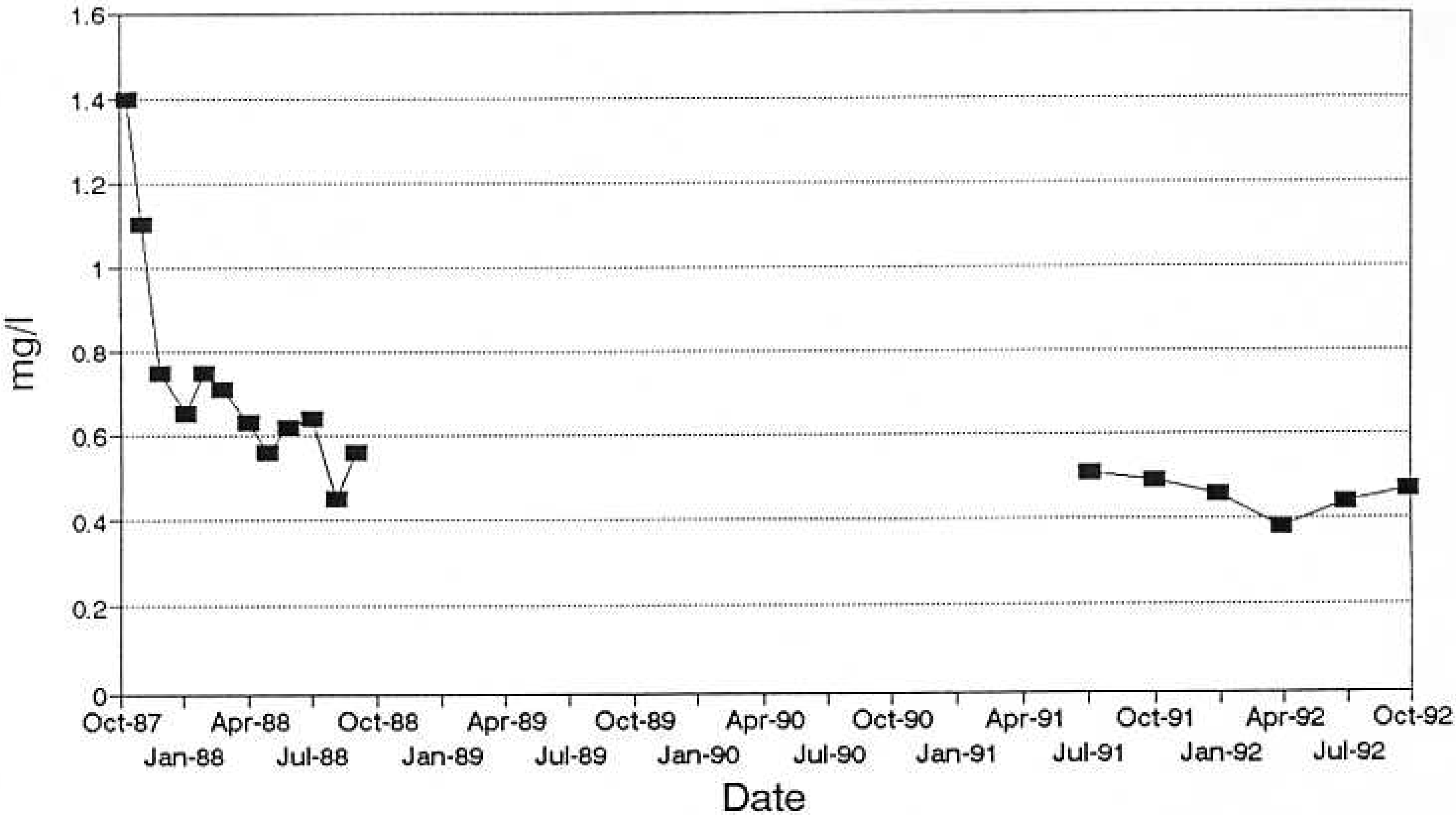
# Groundwater Quality Results
## Manganese - MW1000P




Preventative Action Limit (PAL) = 0.025 mg/l

Enforcement Standard (ES) = 0.05 mg/l

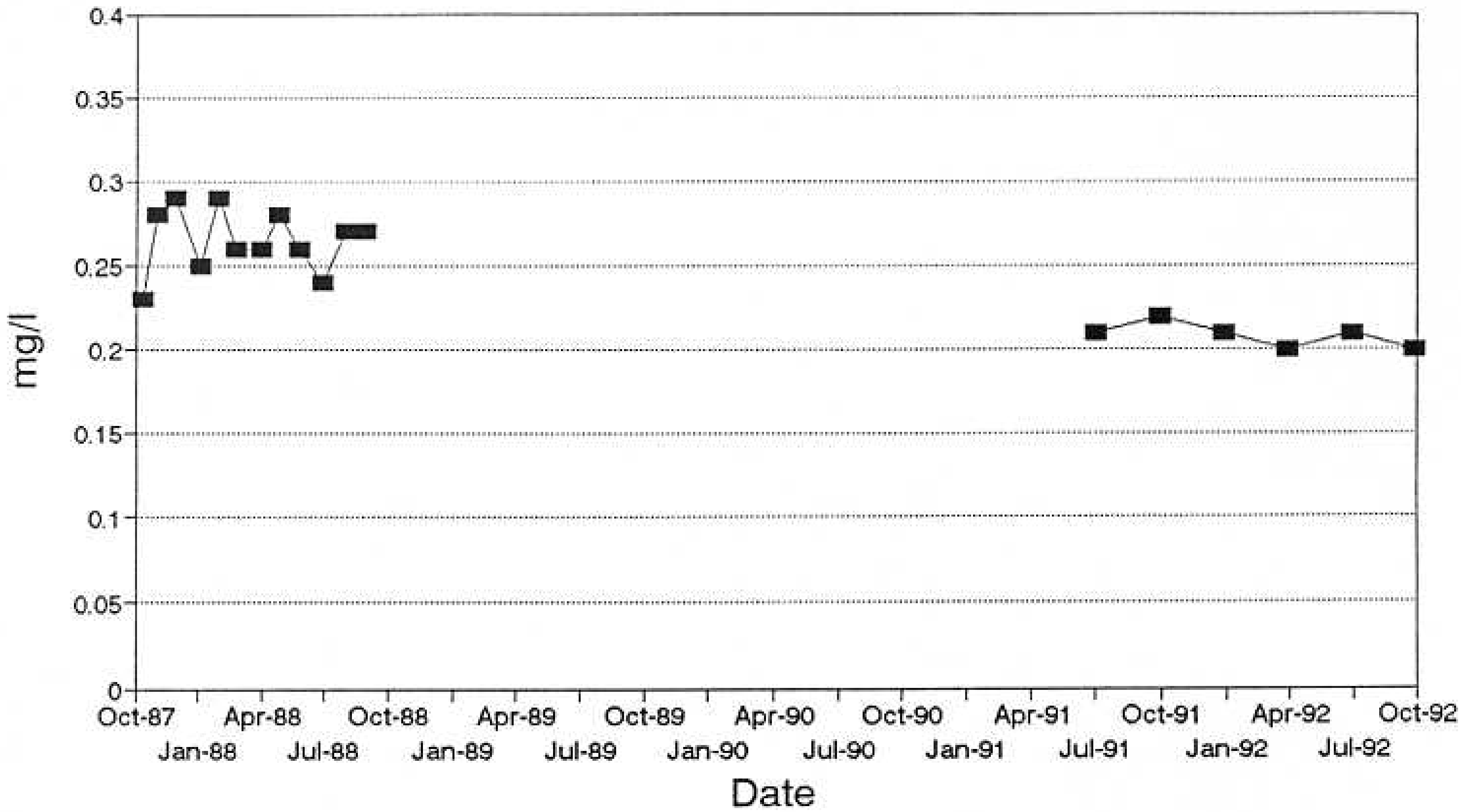
# Groundwater Quality Results
## Manganese - MW1005




Preventative Action Limit (PAL) = 0.025 mg/l

Enforcement Standard (ES) = 0.05 mg/l

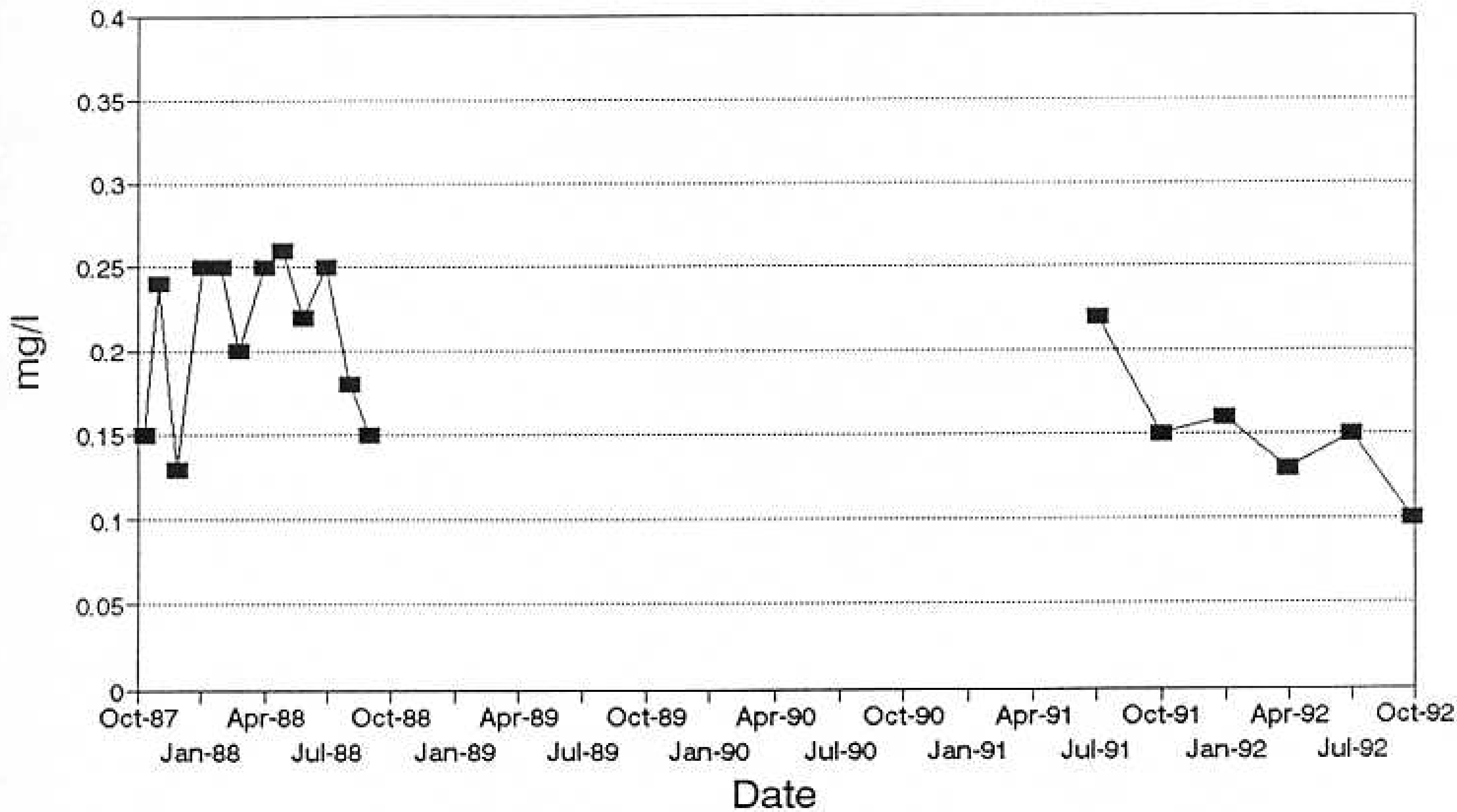
# Groundwater Quality Results
## Manganese - MW1005S




Preventative Action Limit (PAL) = 0.025 mg/l

Enforcement Standard (ES) = 0.05 mg/l

# Groundwater Quality Results
## Manganese - MW1005P




Preventative Action Limit (PAL) = 0.025 mg/l

Enforcement Standard (ES) = 0.05 mg/l