



Route 3, Box 7
Gallup, New Mexico
87301

505
722-3833

March 19, 1999

Mr. Benito J. Garcia
Bureau Chief
Hazardous and Radioactive Materials Bureau
2044 Galisteo
P. O. Box 26110
Santa Fe, New Mexico 87502

**RE: 1998 Annual Groundwater Report
RCRA Part B Permit NMD 000333211-2**

Dear Mr. Garcia:

Pursuant to the requirements of the above captioned permit, the Annual Groundwater Report for sampling performed in 1998 is enclosed. No unusual results were observed as a result of the 1998 sampling events.

If you require additional information or have any questions regarding this report, please contact me at (505) 722-0258 or Dorinda Mancini at (505) 722-0227.

Sincerely,

Stephen C. Morris
Environmental Specialist, Ciniza Refinery

cc: Dave Pavlich, Environmental Superintendent, Ciniza Refinery
Dorinda Mancini, Environmental Manager, Ciniza Refinery
Sarah Allen, Corporate Counsel, Giant Industries, Inc.

**ANNUAL GROUNDWATER
REPORT
1998
GIANT REFINING CO.
CINIZA**

MONITORING WELL IDENTIFICATION REPORT

Giant Refining Company - Ciniza Refinery

FACILITY NAME	Giant Refining Co. - Ciniza
EPA I.D. NUMBER	NMD000333211-2
COUNTY	McKinley
WELL NUMBER	MW-1
WELL LOCATION (LONGITUDE)	108° 25' 36"
WELL LOCATION (LATITUDE)	35° 29' 08"
NEW MEXICO STATE PLANE	(X) 320,903.76 (Y) 1,636,112.13
AQUIFER NAME	Sonsela
AQUIFER CONFINED xx	UNCONFINED
WELL INSTALLATION DATE	10/14/81
DRILLING METHOD	Cable
INNER CASING DIAMETER	5.0"
BOREHOLE DIAMETER	10.0"
CASING MATERIAL	PVC
METHOD OF DEVELOPMENT	Compr
ELEV. BOTTOM OF BOREHOLE	6745.80
ELEV. BOTTOM OF WELL CASING	6745.80
ELEV. BOTTOM OF SCREENED INT.	6750.80
ELEVATION OF SCREENED INTERVAL	6760.80
SURVEYED ELEVATION OF CASING TOP	6878.52

MONITORING WELL IDENTIFICATION REPORT

Giant Refining Company - Ciniza Refinery

FACILITY NAME	Giant Refining Co. - Ciniza
EPA I.D. NUMBER	NMD000333211-2
COUNTY	McKinley
WELL NUMBER	MW-2
WELL LOCATION (LONGITUDE)	108° 26' 00"
WELL LOCATION (LATITUDE)	35° 29' 43"
NEW MEXICO STATE PLANE	(X) 321,035.23 (Y) 1,636,184.06
AQUIFER NAME	Sonsela
AQUIFER CONFINED xx	UNCONFINED
WELL INSTALLATION DATE	10/15/81
DRILLING METHOD	Cable
INNER CASING DIAMETER	5.0"
BOREHOLE DIAMETER	10.0"
CASING MATERIAL	PVC
METHOD OF DEVELOPMENT	Compr
ELEV. BOTTOM OF BOREHOLE	6741.90
ELEV. BOTTOM OF WELL CASING	6741.90
ELEV. BOTTOM OF SCREENED INT.	6747.90
ELEVATION OF SCREENED INTERVAL	6847.90
SURVEYED ELEVATION OF CASING TOP	6880.84

MONITORING WELL IDENTIFICATION REPORT

Giant Refining Company - Ciniza Refinery

FACILITY NAME	Giant Refining Co. - Ciniza
EPA I.D. NUMBER	NMD000333211-2
COUNTY	McKinley
WELL NUMBER	MW-4
WELL LOCATION (LONGITUDE)	108° 26' 54"
WELL LOCATION (LATITUDE)	35° 29' 30"
NEW MEXICO STATE PLANE	(X) 321,602.07 (Y) 1,635,066.25
AQUIFER NAME	Sonsela
AQUIFER CONFINED xx	UNCONFINED
WELL INSTALLATION DATE	10/16/81
DRILLING METHOD	Cable
INNER CASING DIAMETER	5.0"
BOREHOLE DIAMETER	10.0"
CASING MATERIAL	PVC
METHOD OF DEVELOPMENT	Compr
ELEV. BOTTOM OF BOREHOLE	6761.60
ELEV. BOTTOM OF WELL CASING	6761.60
ELEV. BOTTOM OF SCREENED INT.	6761.60
ELEVATION OF SCREENED INTERVAL	6781.60
SURVEYED ELEVATION OF CASING TOP	6882.54

MONITORING WELL IDENTIFICATION REPORT

Giant Refining Company - Ciniza Refinery

FACILITY NAME	Giant Refining Co. - Ciniza
EPA I.D. NUMBER	NMD000333211-2
COUNTY	McKinley
WELL NUMBER	MW-5
WELL LOCATION (LONGITUDE)	108° 25' 57"
WELL LOCATION (LATITUDE)	35° 29' 43"
NEW MEXICO STATE PLANE	(X) 321,233.03 (Y) 1,636,212.58
AQUIFER NAME	Sonsela
AQUIFER CONFINED xx	UNCONFINED
WELL INSTALLATION DATE	7/21/86
DRILLING METHOD	HLWAG & AIRRT
INNER CASING DIAMETER	5.0"
BOREHOLE DIAMETER	10.0"
CASING MATERIAL	PVC
METHOD OF DEVELOPMENT	Compr
ELEV. BOTTOM OF BOREHOLE	6746.80
ELEV. BOTTOM OF WELL CASING	6753.30
ELEV. BOTTOM OF SCREENED INT.	6758.30
ELEVATION OF SCREENED INTERVAL	6768.80
SURVEYED ELEVATION OF CASING TOP	6883.32

MONITORING WELL IDENTIFICATION REPORT

Giant Refining Company - Ciniza Refinery

FACILITY NAME	Giant Refining Co. - Ciniza
EPA I.D. NUMBER	NMD000333211-2
COUNTY	McKinley
WELL NUMBER	OW-11
WELL LOCATION (LONGITUDE)	108° 25' 36"
WELL LOCATION (LATITUDE)	35° 29' 08"
NEW MEXICO STATE PLANE	(X) 323,167.68 (Y) 1,632,185.21
AQUIFER NAME	Sonsela?
AQUIFER CONFINED xx	UNCONFINED
WELL INSTALLATION DATE	12/30/80
DRILLING METHOD	Cable
INNER CASING DIAMETER	4.0"
BOREHOLE DIAMETER	8.0"
CASING MATERIAL	PVC
METHOD OF DEVELOPMENT	Compr
ELEV. BOTTOM OF BOREHOLE	6773.00
ELEV. BOTTOM OF WELL CASING	6773.00
ELEV. BOTTOM OF SCREENED INT.	6858.00
ELEVATION OF SCREENED INTERVAL	6880.00
SURVEYED ELEVATION OF CASING TOP	6923.89

MONITORING WELL IDENTIFICATION REPORT

Giant Refining Company - Ciniza Refinery

FACILITY NAME	Giant Refining Co. - Ciniza
EPA I.D. NUMBER	NMD000333211-2
COUNTY	McKinley
WELL NUMBER	SMW-3
WELL LOCATION (LONGITUDE)	108° 25' 56"
WELL LOCATION (LATITUDE)	35° 29' 40"
NEW MEXICO STATE PLANE	(X) 321,397.90 (Y) 1,635,648.75
AQUIFER NAME	Unnamed *
AQUIFER CONFINED xx	UNCONFINED
WELL INSTALLATION DATE	10/1/85
DRILLING METHOD	HLWAG
INNER CASING DIAMETER	2.0"
BOREHOLE DIAMETER	6.5"
CASING MATERIAL	SS304
METHOD OF DEVELOPMENT	Compr
ELEV. BOTTOM OF BOREHOLE	6836.15
ELEV. BOTTOM OF WELL CASING	6838.65
ELEV. BOTTOM OF SCREENED INT.	6841.65
ELEVATION OF SCREENED INTERVAL	6861.65
SURVEYED ELEVATION OF CASING TOP	6884.56

* The well is completed in a combination of fluvially-derived sands of the valley floor and an alluvially-derived zone lying directly on top of the shales of the Chinle.

MONITORING WELL IDENTIFICATION REPORT

Giant Refining Company - Ciniza Refinery

FACILITY NAME	Giant Refining Co. - Ciniza
EPA I.D. NUMBER	NMD000333211-2
COUNTY	McKinley
WELL NUMBER	SMW-4
WELL LOCATION (LONGITUDE)	108° 26' 01"
WELL LOCATION (LATITUDE)	35° 29' 44"
NEW MEXICO STATE PLANE	(X) 321,397.90 (Y) 1,635,948.75
AQUIFER NAME	Unnamed *
AQUIFER CONFINED xx	UNCONFINED
WELL INSTALLATION DATE	9/25/85
DRILLING METHOD	HLWAG
INNER CASING DIAMETER	2.0"
BOREHOLE DIAMETER	6.5"
CASING MATERIAL	SS304
METHOD OF DEVELOPMENT	Compr
ELEV. BOTTOM OF BOREHOLE	6806.74
ELEV. BOTTOM OF WELL CASING	6807.84
ELEV. BOTTOM OF SCREENED INT.	6810.84
ELEVATION OF SCREENED INTERVAL	6830.84
SURVEYED ELEVATION OF CASING TOP	6880.08

* The well is completed in a combination of fluvially-derived sands of the valley floor and an alluvially-derived zone lying directly on top of the shales of the Chinle.

MONITORING WELL IDENTIFICATION REPORT

Giant Refining Company - Ciniza Refinery

FACILITY NAME	Giant Refining Co. - Ciniza
EPA I.D. NUMBER	NMD000333211-2
COUNTY	McKinley
WELL NUMBER	SMW-5
WELL LOCATION (LONGITUDE)	108° 26' 03"
WELL LOCATION (LATITUDE)	35° 29' 41"
NEW MEXICO STATE PLANE	(X) 320,778.61 (Y) 1,636,054.28
AQUIFER NAME	Unnamed *
AQUIFER CONFINED xx	UNCONFINED
WELL INSTALLATION DATE	9/25/85
DRILLING METHOD	HLWAG
INNER CASING DIAMETER	2.0"
BOREHOLE DIAMETER	6.5"
CASING MATERIAL	SS304
METHOD OF DEVELOPMENT	Compr
ELEV. BOTTOM OF BOREHOLE	6800.68
ELEV. BOTTOM OF WELL CASING	6801.78
ELEV. BOTTOM OF SCREENED INT.	6804.78
ELEVATION OF SCREENED INTERVAL	6824.78
SURVEYED ELEVATION OF CASING TOP	6878.02

* The well is completed in a combination of fluvially-derived sands of the valley floor and an alluvially-derived zone lying directly on top of the shales of the Chinle.

Calculation Sheet for Semi-Annual Evaluation of Indicator Parameters

MW-1 Giant Refining - Ciniza (Down Gradient Well)

Parameter: pH

Background Indicator Values: $X_b = 8.51$ $S_b^2 = 0.015$
 $W_b = 0.00937$ $t_b = 2.947$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	8.86	0.0030
	2	8.94	0.0006
	3	8.94	0.0006
	4	8.92	0.0000

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 8.92$ Variance $S_m^2 = [\text{Sum of (Value- X_m)²}] / 3 = 0.0014$

$$t_m (\text{pH}) = 5.841$$

$$W_m = S_m^2 / n_m = 0.0004$$

$$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 4.11$$

$$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 3.05 \quad |t^*| > t_c : \text{Statistically significant change possible.}$$

Parameter: Specific Conductivity

Background Indicator Values: $X_b = 984$ $S_b^2 = 1487$
 $W_b = 92.9375$ $t_b = 2.602$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	1092	5.0625
	2	1098	14.0625
	3	1090	18.0625
	4	1097	7.5625

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 1094$ Variance $S_m^2 = [\text{Sum of (Value- X_m)²}] / 3 = 14.9167$

$$t_m (\text{Specific Conduct.}) = 4.541$$

$$W_m = S_m^2 / n_m = 3.7292$$

$$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 11.21$$

$$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 2.68 \quad t^* > t_c : \text{Statistically significant change possible.}$$

Note: W_b, W_m = Special Weighting Factors; t_b, t_m = Standard T-Table Levels of Significance; t^* = the t-statistic; and t_c = the comparison t-statistic.
 This statistical treatment is set forth in 40 CFR Part 264, Appendix IV: *Cochran's Approximation To The Behrens-Fisher Students' T-Test.*

Calculation Sheet for Semi-Annual Evaluation of Indicator Parameters

MW-1 Giant Refining - Ciniza (Down Gradient Well)

Parameter: pH

Background Indicator Values: $X_b = 8.51$ $S_b^2 = 0.015$
 $W_b = 0.00937$ $t_b = 2.947$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	8.74	0.0005
	2	8.73	0.0002
	3	8.71	0.0001
	4	8.69	0.0008

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 8.72$ Variance $S_m^2 = [\text{Sum of (Value- X_m)²}] / 3 = 0.0005$

$t_m (\text{pH}) = 5.841$

$W_m = S_m^2 / n_m = 0.0001$

$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 2.13$

$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 2.98$ $|t^*| < t_c$: Statistically significant change not likely.

Parameter: Specific Conductivity

Background Indicator Values: $X_b = 984$ $S_b^2 = 1487$
 $W_b = 92.9375$ $t_b = 2.602$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	1110	12.2500
	2	1106	0.2500
	3	1104	6.2500
	4	1106	0.2500

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 1107$ Variance $S_m^2 = [\text{Sum of (Value- X_m)²}] / 3 = 6.3333$

$t_m (\text{Specific Conduct.}) = 4.541$

$W_m = S_m^2 / n_m = 1.5833$

$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 12.60$

$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 2.63$ $t^* > t_c$: Statistically significant change possible.

Note: W_b, W_m = Special Weighting Factors; t_b, t_m = Standard T-Table Levels of Significance; t^* = the t-statistic; and t_c = the comparison t-statistic.
 This statistical treatment is set forth in 40 CFR Part 264, Appendix IV: *Cochran's Approximation To The Behrens-Fisher Students' T-Test*.

Calculation Sheet for Semi-Annual Evaluation of Indicator Parameters

**MW-2 Giant Refining - Ciniza
(Down Gradient Well)**

Parameter: pH

Background Indicator Values: $X_b = 8.51$ $S_b^2 = 0.015$
 $W_b = 0.00937$ $t_b = 2.947$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	8.86	0.0002
	2	8.89	0.0003
	3	8.85	0.0005
	4	8.89	0.0003

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 8.87$ Variance $S_m^2 = [\text{Sum of (Value-X}_m)^2] / 3 = 0.0004$

$$t_m (\text{pH}) = 5.841$$

$$W_m = S_m^2 / n_m = 0.0001$$

$$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 3.72$$

$$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 2.98 \quad |t^*| > t_c : \text{Statistically significant change possible.}$$

Parameter: Specific Conductivity

Background Indicator Values: $X_b = 984$ $S_b^2 = 1487$
 $W_b = 92.9375$ $t_b = 2.602$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	1090	1.5625
	2	1090	1.5625
	3	1094	7.5625
	4	1091	0.0625

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 1091$ Variance $S_m^2 = [\text{Sum of (Value-X}_m)^2] / 3 = 3.5833$

$$t_m (\text{Specific Conduct.}) = 4.541$$

$$W_m = S_m^2 / n_m = 0.8958$$

$$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 11.07$$

$$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 2.62 \quad t^* > t_c : \text{Statistically significant change possible.}$$

Note: W_b, W_m = Special Weighting Factors; t_b, t_m = Standard T-Table Levels of Significance; t^* = the t-statistic; and t_c = the comparison t-statistic.
 This statistical treatment is set forth in 40 CFR Part 264, Appendix IV: *Cochran's Approximation To The Behrens-Fisher Students' T-Test.*

Calculation Sheet for Semi-Annual Evaluation of Indicator Parameters

**MW-2 Giant Refining - Ciniza
(Down Gradient Well)**

Parameter: pH

Background Indicator Values: $X_b = 8.51$ $S_b^2 = 0.015$
 $W_b = 0.00937$ $t_b = 2.947$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	8.67	0.0008
	2	8.68	0.0014
	3	8.65	0.0001
	4	8.57	0.0053

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 8.64$ Variance $S_m^2 = [\text{Sum of (Value-X}_m)^2] / 3 = 0.0025$

$t_m (\text{pH}) = 5.841$

$W_m = S_m^2 / n_m = 0.0006$

$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 1.33$

$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 3.13$ $|t^*| < t_c$: Statistically significant change not likely.

Parameter: Specific Conductivity

Background Indicator Values: $X_b = 984$ $S_b^2 = 1487$
 $W_b = 92.9375$ $t_b = 2.602$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	1154	217.5625
	2	1133	39.0625
	3	1137	5.0625
	4	1133	39.0625

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 1139$ Variance $S_m^2 = [\text{Sum of (Value-X}_m)^2] / 3 = 100.2500$

$t_m (\text{Specific Conduct.}) = 4.541$

$W_m = S_m^2 / n_m = 25.0625$

$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 14.29$

$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 3.01$ $t^* > t_c$: Statistically significant change possible.

Note: W_b, W_m = Special Weighting Factors; t_b, t_m = Standard T-Table Levels of Significance; t^* = the t-statistic; and t_c = the comparison t-statistic.
 This statistical treatment is set forth in 40 CFR Part 264, Appendix IV: *Cochran's Approximation To The Behrens-Fisher Students' T-Test*.

Calculation Sheet for Semi-Annual Evaluation of Indicator Parameters

MW-4 Giant Refining - Ciniza (Down Gradient Well)

Parameter: pH

Background Indicator Values: $X_b = 8.51$ $S_b^2 = 0.015$
 $W_b = 0.00937$ $t_b = 2.947$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	8.41	0.0005
	2	8.45	0.0003
	3	8.43	0.0000
	4	8.44	0.0001

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 8.43$ Variance $S_m^2 = [\text{Sum of (Value- X_m)²}] / 3 = 0.0003$

$$t_m (\text{pH}) = 5.841$$

$$W_m = S_m^2 / n_m = 0.0001$$

$$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = -0.80$$

$$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 2.97 \quad |t^*| < t_c : \text{Statistically significant change not likely.}$$

Parameter: Specific Conductivity

Background Indicator Values: $X_b = 984$ $S_b^2 = 1487$
 $W_b = 92.9375$ $t_b = 2.602$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	1080	650.2500
	2	1115	90.2500
	3	1100	30.2500
	4	1127	462.2500

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 1106$ Variance $S_m^2 = [\text{Sum of (Value- X_m)²}] / 3 = 411.0000$

$$t_m (\text{Specific Conduct.}) = 4.541$$

$$W_m = S_m^2 / n_m = 102.7500$$

$$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 8.69$$

$$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 3.62 \quad t^* > t_c : \text{Statistically significant change possible.}$$

Note: W_b, W_m = Special Weighting Factors; t_b, t_m = Standard T-Table Levels of Significance; t^* = the t-statistic; and t_c = the comparison t-statistic.
 This statistical treatment is set forth in 40 CFR Part 264, Appendix IV: *Cochran's Approximation To The Behrens-Fisher Students' T-Test*.

Calculation Sheet for Semi-Annual Evaluation of Indicator Parameters

MW-4 Giant Refining - Ciniza (Down Gradient Well)

Parameter: pH

Background Indicator Values: $X_b = 8.51$ $S_b^2 = 0.015$
 $W_b = 0.00937$ $t_b = 2.947$

Current well sample values:	Sample	Value	$(\text{Value}-X_m)^2$
	1	8.08	0.0016
	2	8.14	0.0004
	3	8.12	0.0000
	4	8.14	0.0004

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 8.12$ Variance $S_m^2 = [\text{Sum of } (\text{Value}-X_m)^2] / 3 = 0.0008$

$$t_m (\text{pH}) = 5.841$$

$$W_m = S_m^2 / n_m = 0.0002$$

$$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = -3.99$$

$$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 3.01 \quad |t^*| > t_c : \text{Statistically significant change possible.}$$

Parameter: Specific Conductivity

Background Indicator Values: $X_b = 984$ $S_b^2 = 1487$
 $W_b = 92.9375$ $t_b = 2.602$

Current well sample values:	Sample	Value	$(\text{Value}-X_m)^2$
	1	1124	370.5625
	2	1149	33.0625
	3	1151	60.0625
	4	1149	33.0625

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 1143$ Variance $S_m^2 = [\text{Sum of } (\text{Value}-X_m)^2] / 3 = 165.5833$

$$t_m (\text{Specific Conduct.}) = 4.541$$

$$W_m = S_m^2 / n_m = 41.3958$$

$$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 13.74$$

$$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 3.20 \quad t^* > t_c : \text{Statistically significant change possible.}$$

Note: W_b, W_m = Special Weighting Factors; t_b, t_m = Standard T-Table Levels of Significance; t^* = the t-statistic; and t_c = the comparison t-statistic.
 This statistical treatment is set forth in 40 CFR Part 264, Appendix IV: *Cochran's Approximation To The Behrens-Fisher Students' T-Test*.

Calculation Sheet for Semi-Annual Evaluation of Indicator Parameters

MW-5 Giant Refining - Ciniza (Down Gradient Well)

Parameter: pH

Background Indicator Values: $X_b = 8.51$ $S_b^2 = 0.015$
 $W_b = 0.00937$ $t_b = 2.947$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	8.81	0.0005
	2	8.85	0.0003
	3	8.82	0.0002
	4	8.85	0.0003

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 8.83$ Variance $S_m^2 = [\text{Sum of (Value- X_m)²}] / 3 = 0.0004$

$$t_m (\text{pH}) = 5.841$$

$$W_m = S_m^2 / n_m = 0.0001$$

$$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 3.31$$

$$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 2.98 \quad |t^*| > t_c : \text{Statistically significant change possible.}$$

Parameter: Specific Conductivity

Background Indicator Values: $X_b = 984$ $S_b^2 = 1487$
 $W_b = 92.9375$ $t_b = 2.602$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	1120	138.0625
	2	1114	33.0625
	3	1100	68.0625
	4	1099	85.5625

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 1108$ Variance $S_m^2 = [\text{Sum of (Value- X_m)²}] / 3 = 108.2500$

$$t_m (\text{Specific Conduct.}) = 4.541$$

$$W_m = S_m^2 / n_m = 27.0625$$

$$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 11.34$$

$$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 3.04 \quad t^* > t_c : \text{Statistically significant change possible.}$$

Note: W_b, W_m = Special Weighting Factors; t_b, t_m = Standard T-Table Levels of Significance; t^* = the t-statistic; and t_c = the comparison t-statistic.
 This statistical treatment is set forth in 40 CFR Part 264, Appendix IV: *Cochran's Approximation To The Behrens-Fisher Students' T-Test*.

Calculation Sheet for Semi-Annual Evaluation of Indicator Parameters

**MW-5 Giant Refining - Ciniza
(Down Gradient Well)**

Parameter: pH

Background Indicator Values: $X_b = 8.51$ $S_b^2 = 0.015$
 $W_b = 0.00937$ $t_b = 2.947$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	8.60	0.0011
	2	8.65	0.0003
	3	8.64	0.0001
	4	8.64	0.0001

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 8.63$ Variance $S_m^2 = [\text{Sum of (Value- X_m)²}] / 3 = 0.0005$

$$t_m (\text{pH}) = 5.841$$

$$W_m = S_m^2 / n_m = 0.0001$$

$$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 1.26$$

$$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 2.98 \quad |t^*| < t_c : \text{Statistically significant change not likely.}$$

Parameter: Specific Conductivity

Background Indicator Values: $X_b = 984$ $S_b^2 = 1487$
 $W_b = 92.9375$ $t_b = 2.602$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	1140	7.5625
	2	1136	1.5625
	3	1134	10.5625
	4	1139	3.0625

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 1137$ Variance $S_m^2 = [\text{Sum of (Value- X_m)²}] / 3 = 7.5833$

$$t_m (\text{Specific Conduct.}) = 4.541$$

$$W_m = S_m^2 / n_m = 1.8958$$

$$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 15.74$$

$$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 2.64 \quad t^* > t_c : \text{Statistically significant change possible.}$$

Note: W_b, W_m = Special Weighting Factors; t_b, t_m = Standard T-Table Levels of Significance; t^* = the t-statistic; and t_c = the comparison t-statistic.
 This statistical treatment is set forth in 40 CFR Part 264, Appendix IV: *Cochran's Approximation To The Behrens-Fisher Students' T-Test.*

Calculation Sheet for Semi-Annual Evaluation of Indicator Parameters

**OW-11 Giant Refining - Ciniza
(Down Gradient Well)**

Parameter: pH

Background Indicator Values: $X_b = 8.51$ $S_b^2 = 0.015$
 $W_b = 0.00937$ $t_b = 2.947$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	8.15	0.0009
	2	8.12	0.0000
	3	8.11	0.0001
	4	8.10	0.0004

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 8.12$ Variance $S_m^2 = [\text{Sum of (Value-X}_m)^2] / 3 = 0.0005$

$t_m (\text{pH}) = 5.841$

$W_m = S_m^2 / n_m = 0.0001$

$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = -4.00$

$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 2.98$ $|t^*| > t_c$: Statistically significant change possible.

Parameter: Specific Conductivity

Background Indicator Values: $X_b = 984$ $S_b^2 = 1487$
 $W_b = 92.9375$ $t_b = 2.602$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	2450	6.2500
	2	2440	56.2500
	3	2450	6.2500
	4	2450	6.2500

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 2448$ Variance $S_m^2 = [\text{Sum of (Value-X}_m)^2] / 3 = 25.0000$

$t_m (\text{Specific Conduct.}) = 4.541$

$W_m = S_m^2 / n_m = 6.2500$

$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 146.95$

$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 2.72$ $t^* > t_c$: Statistically significant change possible.

Note: W_b, W_m = Special Weighting Factors; t_b, t_m = Standard T-Table Levels of Significance; t^* = the t-statistic; and t_c = the comparison t-statistic.
 This statistical treatment is set forth in 40 CFR Part 264, Appendix IV: *Cochran's Approximation To The Behrens-Fisher Students' T-Test*.

Calculation Sheet for Semi-Annual Evaluation of Indicator Parameters

**OW-11 Giant Refining - Ciniza
(Down Gradient Well)**

Parameter: pH

Background Indicator Values: $X_b = 8.51$ $S_b^2 = 0.015$
 $W_b = 0.00937$ $t_b = 2.947$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	8.03	0.0014
	2	7.99	0.0000
	3	7.95	0.0018
	4	8.00	0.0001

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 7.99$ Variance $S_m^2 = [\text{Sum of (Value-X}_m)^2] / 3 = 0.0011$

$t_m (\text{pH}) = 5.841$

$W_m = S_m^2 / n_m = 0.0003$

$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = -5.27$

$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 3.03$ $|t^*| > t_c$: Statistically significant change possible.

Parameter: Specific Conductivity

Background Indicator Values: $X_b = 984$ $S_b^2 = 1487$
 $W_b = 92.9375$ $t_b = 2.602$

Current well sample values:	<u>Sample</u>	<u>Value</u>	<u>(Value-X_m)²</u>
	1	2550	756.2500
	2	2530	56.2500
	3	2510	156.2500
	4	2500	506.2500

Mean $X_m = (\text{Sum of Sample Values}) / 4 = 2523$ Variance $S_m^2 = [\text{Sum of (Value-X}_m)^2] / 3 = 491.6667$

$t_m (\text{Specific Conduct.}) = 4.541$

$W_m = S_m^2 / n_m = 122.9167$

$t^* = (X_m - X_b) / (W_m + W_b)^{1/2} = 104.72$

$t_c = [(W_b \times t_b) + (W_m \times t_m)] / (W_b + W_m) = 3.71$ $t^* > t_c$: Statistically significant change possible.

Note: W_b, W_m = Special Weighting Factors; t_b, t_m = Standard T-Table Levels of Significance; t^* = the t-statistic; and t_c = the comparison t-statistic.
 This statistical treatment is set forth in 40 CFR Part 264, Appendix IV: *Cochran's Approximation To The Behrens-Fisher Students' T-Test*.

Tolerance Interval

SMW-3 Giant Refining - Ciniza

pH

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Fall 97 sampling period	7.24	7.80	0.20	7.40 - 8.20	(Does exceed tolerance limit.)
Spring 98 sampling period	7.52	8.00	0.20	7.59 - 8.41	(Does exceed tolerance limit.)

Specific Conductivity

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Fall 97 sampling period	2935	3181	322	2537 - 3824	(Does not exceed tolerance limit.)
Spring 98 sampling period	2865	3168	321	2525 - 3810	(Does not exceed tolerance limit.)

Chromium

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Fall 97 sampling period	0.005	0.055	0.150	0.000 - 0.356	(Does not exceed tolerance limit.)
Spring 98 sampling period	0.005	0.053	0.147	0.000 - 0.348	(Does not exceed tolerance limit.)

Lead

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Fall 97 sampling period	0.003	0.024	0.078	0.000 - 0.180	(Does not exceed tolerance limit.)
Spring 98 sampling period	0.003	0.023	0.076	0.000 - 0.176	(Does not exceed tolerance limit.)

Tolerance Interval = (Mean ± 2 Standard Deviations)

Tolerance Interval

SMW-3 Giant Refining - Ciniza

pH

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Spring 98 sampling period	7.52	7.79	0.20	7.38 - 8.20	(Does not exceed tolerance limit.)
Fall 98 sampling period	7.23	8.00	0.23	7.54 - 8.46	(Does exceed tolerance limit.)

Specific Conductivity

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Spring 98 sampling period	2865	3168	321	2525 - 3810	(Does not exceed tolerance limit.)
Fall 98 sampling period	2928	3158	318	2522 - 3794	(Does not exceed tolerance limit.)

Chromium

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Spring 98 sampling period	0.005	0.053	0.147	0.000 - 0.348	(Does not exceed tolerance limit.)
Fall 98 sampling period	0.010	0.051	0.144	0.000 - 0.340	(Does not exceed tolerance limit.)

Lead

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Spring 98 sampling period	0.003	0.023	0.076	0.000 - 0.176	(Does not exceed tolerance limit.)
Fall 98 sampling period	0.003	0.022	0.075	0.000 - 0.172	(Does not exceed tolerance limit.)

Tolerance Interval = (Mean ± 2 Standard Deviations)

Tolerance Interval

SMW-4 Giant Refining - Ciniza

pH

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Fall 97 sampling period	8.28	8.35	0.19	7.96 - 8.73	(Does not exceed tolerance limit.)
Spring 98 sampling period	8.29	8.34	0.19	7.96 - 8.72	(Does not exceed tolerance limit.)

Specific Conductivity

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Fall 97 sampling period	1257	1296	169	958 - 1635	(Does not exceed tolerance limit.)
Spring 98 sampling period	1256	1295	166	962 - 1627	(Does not exceed tolerance limit.)

Chromium

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Fall 97 sampling period	0.005	0.010	0.014	0.000 - 0.038	(Does not exceed tolerance limit.)
Spring 98 sampling period	0.005	0.010	0.013	0.000 - 0.037	(Does not exceed tolerance limit.)

Lead

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Fall 97 sampling period	0.003	0.007	0.021	0.000 - 0.049	(Does not exceed tolerance limit.)
Spring 98 sampling period	0.003	0.007	0.020	0.000 - 0.048	(Does not exceed tolerance limit.)

Tolerance Interval = (Mean ± 2 Standard Deviations)

Tolerance Interval

SMW-4 Giant Refining - Ciniza

pH

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Spring 98 sampling period	8.29	8.34	0.19	7.96 - 8.72	(Does not exceed tolerance limit.)
Fall 98 sampling period	7.91	8.33	0.20	7.92 - 8.74	(Does exceed tolerance limit.)

Specific Conductivity

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Spring 98 sampling period	1256	1295	166	962 - 1627	(Does not exceed tolerance limit.)
Fall 98 sampling period	1213	1292	164	964 - 1620	(Does not exceed tolerance limit.)

Chromium

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Spring 98 sampling period	0.005	0.010	0.013	0.000 - 0.037	(Does not exceed tolerance limit.)
Fall 98 sampling period	0.005	0.010	0.013	0.000 - 0.037	(Does not exceed tolerance limit.)

Lead

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Spring 98 sampling period	0.003	0.007	0.020	0.000 - 0.048	(Does not exceed tolerance limit.)
Fall 98 sampling period	0.003	0.007	0.020	0.000 - 0.047	(Does not exceed tolerance limit.)

Tolerance Interval = (Mean ± 2 Standard Deviations)

Tolerance Interval
SMW-5 Giant Refining - Ciniza

pH

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Fall 97 sampling period	8.68	8.56	0.27	8.02 - 9.09	(Does not exceed tolerance limit.)
Spring 98 sampling period	8.51	8.56	0.26	8.03 - 9.08	(Does not exceed tolerance limit.)

Specific Conductivity

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Fall 97 sampling period	1170	1142	71	999 - 1285	(Does not exceed tolerance limit.)
Spring 98 sampling period	1122	1141	70	1001 - 1282	(Does not exceed tolerance limit.)

Chromium

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Fall 97 sampling period	0.005	0.022	0.030	0.000 - 0.082	(Does not exceed tolerance limit.)
Spring 98 sampling period	0.013	0.022	0.030	0.000 - 0.081	(Does not exceed tolerance limit.)

Lead

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Fall 97 sampling period	0.003	0.013	0.047	0.000 - 0.106	(Does not exceed tolerance limit.)
Spring 98 sampling period	0.003	0.012	0.046	0.000 - 0.104	(Does not exceed tolerance limit.)

Tolerance Interval = (Mean ± 2 Standard Deviations)

Tolerance Interval

SMW-5 Giant Refining - Ciniza

pH

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Spring 98 sampling period	8.51	8.56	0.26	8.03 - 9.08	(Does not exceed tolerance limit.)
Fall 98 sampling period	8.10	8.54	0.27	8.00 - 9.08	(Does not exceed tolerance limit.)

Specific Conductivity

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Spring 98 sampling period	1122	1141	70	1001 - 1282	(Does not exceed tolerance limit.)
Fall 98 sampling period	1136	1141	69	1003 - 1279	(Does not exceed tolerance limit.)

Chromium

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Spring 98 sampling period	0.013	0.022	0.030	0.000 - 0.081	(Does not exceed tolerance limit.)
Fall 98 sampling period	0.015	0.021	0.029	0.000 - 0.080	(Does not exceed tolerance limit.)

Lead

	Current Value	Historic Mean	Historic Standard Deviation	Tolerance Interval	
Spring 98 sampling period	0.003	0.012	0.046	0.000 - 0.104	(Does not exceed tolerance limit.)
Fall 98 sampling period	0.003	0.012	0.045	0.000 - 0.102	(Does not exceed tolerance limit.)

Tolerance Interval = (Mean ± 2 Standard Deviations)

GROUNDWATER ELEVATION MEASUREMENTS

Giant Refining Company - Ciniza

<u>Well No.</u>	<u>Date</u>	<u>Casing Elevation</u>	<u>Depth to Water</u>	<u>Groundwater Elevation</u>
MW-1	Spring 98	6878.52	5.96	6872.56
	Fall 98		5.65	6872.87
MW-2	Spring 98	6880.84	10.04	6870.8
	Fall 98		7.9	6872.94
MW-4	Spring 98	6882.54	6.66	6875.88
	Fall 98		6.4	6876.14
MW-5	Spring 98	6883.32	12.16	6871.16
	Fall 98		10.1	6873.22
OW-11	Spring 98	6923.89	20.25	6903.64
	Fall 98		19.3	6904.59
SMW-3	Spring 98	6884.56	32.08	6852.48
	Fall 98		30.6	6853.96
SMW-4	Spring 98	6880.08	31	6849.08
	Fall 98		29.9	6850.18
SMW-5	Spring 98	6878.02	30.92	6847.1
	Fall 98		30.1	6847.92