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 ENTERED

Environmental Protection Division
Water Quality & RCRA Group (ENV-RCRA)
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Los Alamos, New Mexico 87545
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Date: July 14, 2009
Refer To: ENV-RCRA-09-132
LAUR: 09-04398

U.S. Environmental Protection Agency
Office of Water, Water Permits Division
Mail Code 4203M, ATTN:MSGP Reports
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460

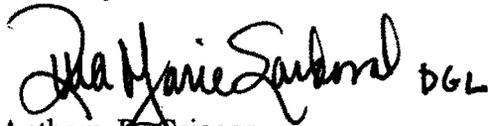
TO WHOM IT MAY CONCERN:

SUBJECT: NPDES PERMIT TRACKING NO. NMR05GB21, MULTI-SECTOR GENERAL PERMIT INDUSTRIAL DISCHARGE MONITORING REPORTS FOR APRIL 2009

Enclosed are Los Alamos National Laboratory's initial Multi-Sector General Permit DMRs (MDMRs) for April 11, 2009 and April 17, 2009 as required under the NPDES MSGP (Permit Tracking No. NMR05GB21) (Enclosure 1 and 2). Also enclosed is the determination of hardness value for receiving waters as required under Section 6.2.1.1 of the MSGP (Enclosure 3).

Please contact Tim Zimmerly at (505) 664-0105 or Terrill Lemke at (505) 665-2397 if you have questions regarding these MDMRs.

Sincerely,

 DGL

for Anthony R. Grieggs
Group Leader
Water Quality & RCRA Group (ENV-RCRA)

ARG:TZ/lm



Enclosures: a/s

Cy: Brent Larsen, U.S.EPA Region 6, Dallas, TX, w/enc.
Glenn Saums, NMED/SWQB, Santa Fe, NM, w/enc.
Bill Olson, NMED/GWQB, Santa Fe, NM, w/enc.
Gene Turner, LASO-EO, w/enc., A316
Michael B. Mallory, PADOPS, w/o enc., A102
Chris Cantwell, ADESHQ, w/o enc., K491
Carla Jacquez, ENV-RCRA, w/enc., K490
Tim Zimmerly, ENV-RCRA, w/enc., K490
ENV-DO File, w/o enc., J978
ENV-RCRA File, w/enc., K490
IRM-RMMSO, w/enc., A150

ENCLOSURE 1



Reason(s) for Submission (Check all that apply):

- Submitting monitoring data (Fill in all Sections).
- Reporting no discharge for all outfalls for this monitoring period (Fill in Sections A, B, C, 1, D, and F).
- Reporting that your site status has changed to inactive and unstaffed (Fill in Sections A, B, F and include date of status change in comment field in Section E.4).
- Reporting that your site status has changed to active (Fill in all Sections and include date of status change in comment field in Section E.4).
- Reporting that no further pollutant reductions are achievable for all outfalls and for all pollutants via Part 6.2.1.2 of the MSGP (Fill in Sections A, B and F).

A. Permit Tracking Number: NMR05GB21

Note: Read instructions before completing this Form.

B. Facility Information

1. Facility Name: Los Alamos National Laboratory

2. Facility Location:

a. Street: Bikini Atoll Rd. SMBB K490

b. City: Los Alamos

c. State: NM d. Zip Code: 87545

3. Additional Facility Information (Optional):

Contact Name: Anthony Grieggs Email: grieggst@lanl.gov

Phone: 505-665-0451 Ext.

4. MDMR Preparer (Complete if MDMR was prepared by someone other than the person signing the certification in Section F)

Prepared by: Timothy Zimmerly

Organization: ENV-RCRA

Email: tzimmer@lanl.gov

Phone: 505-664-0105 Ext.

C. Discharge Information

1. Identify monitoring period:

Check here if proposing alternative monitoring periods due to irregular stormwater runoff. Identify alternative monitoring schedule and indicate for which alternative monitoring period you are reporting monitoring data:

- Quarter 1 (April 1 – June 30) Quarter 1: From 04/01 To 05/31
- Quarter 2 (July 1 – September 30) Quarter 2: From 06/01 To 07/31
- Quarter 3 (October 1 – December 31) Quarter 3: From 08/01 To 09/30
- Quarter 4 (January 1 – March 31) Quarter 4: From 10/01 To 11/30

2. Are you required to monitor for cadmium, copper, chromium, lead, nickel, silver, or zinc? Yes (Complete line item 2.a.) No (Skip to Section D)

2.a. What is the hardness level of the receiving water? 113 mg/L

D. Outfall Information

1. How many outfall(s) are identified in your SWPPP? 24 List name of outfall(s) required to be monitored in table below.

2. Do any of your outfalls discharge substantially identical effluents? YES NO

2.a. If yes, for each monitored outfall, indicate outfall names that are substantially identical in table below.

3.A. Monitored Outfall Name*	3.B. Substantially Identical Outfalls (List name(s) of outfall(s) substantially identical to outfall in 3.A. (if applicable))	3.C. No Discharge?
14-OBOD-1		<input checked="" type="checkbox"/>
15-PHRMX-1		<input checked="" type="checkbox"/>
16-OBOD-1		<input checked="" type="checkbox"/>
3-MFS-1		<input type="checkbox"/>
3-MST-1		<input checked="" type="checkbox"/>

*Reference attachment if additional space needed to complete the table.

D. Outfall Information (continued)

3.A. Monitored Outfall Name	3.B. Substantially Identical Outfalls [List name(s) of outfalls substantially identical to outfall in 3.A. (if applicable)]	3.C. No Discharge?
3-PSP-5	3-PSP-1, 3-PSP-2, 3-PSP-3, 3-PSP-4, 3-PSP-6, 3-PSP-7, 3-PSP-8	<input type="checkbox"/>
3-Sigma-6	3-Sigma-1, 3-Sigma-2, 3-Sigma-3, 3-Sigma-4, 3-Sigma-5, 3-Sigma-7	<input checked="" type="checkbox"/>
3-TS-1		<input type="checkbox"/>
36-OBOD-1		<input checked="" type="checkbox"/>
39-57-OBOD-1		<input checked="" type="checkbox"/>
39-6-OBOD-1		<input checked="" type="checkbox"/>
50-WCRRF-1		<input checked="" type="checkbox"/>
54-G-1		<input checked="" type="checkbox"/>
54-G-2	54-G-2a, 54-G-2b	<input checked="" type="checkbox"/>
54-G-3		<input checked="" type="checkbox"/>
54-G-4	54-G-4a, 54-G-4b, 54-G-4c, 54-G-4d, 54-G-4e	<input checked="" type="checkbox"/>
54-L-1		<input checked="" type="checkbox"/>
54-RANT-1	54-RANT-1a, 54-RANT-1b	<input type="checkbox"/>
55-PF-1	55-PF-2	<input checked="" type="checkbox"/>
60-ABP -1		<input checked="" type="checkbox"/>
60-HEY-1	60-HEY-2, 60-HEY-3, 60-HEY-4, 60-HEY-5, 60-HEY-6	<input type="checkbox"/>
60-MRF-1		<input checked="" type="checkbox"/>
60-RG-3	60-RG-1, 60-RG-2, 60-RG-4, 60-RG-5, 60-RG-6, 60-RG-7	<input checked="" type="checkbox"/>
60-WH-1	60-WH-2, 60-WH-3	<input type="checkbox"/>

Quarterly analytical monitoring was not performed at 60-HEY-1 and 60-WH-1 since these locations are under Sector P and do not require quarterly analytical monitoring under the MSGP. Discharge at these locations was inspected for quarterly visual assessments.

ENCLOSURE 2



Reason(s) for Submission (Check all that apply):

- Submitting monitoring data (Fill in all Sections)
- Reporting no discharge for all outfalls for this monitoring period (Fill in Sections A, B, C.1, D, and F)
- Reporting that your site status has changed to inactive and unstaffed (Fill in Sections A, B, F and include date of status change in comment field in Section E.4)
- Reporting that your site status has changed to active (Fill in all Sections and include date of status change in comment field in Section E.4)
- Reporting that no further pollutant reductions are achievable for all outfalls and for all pollutants via Part 6.2.1.2 of the MSGP (Fill in Sections A, B and F)

A. Permit Tracking Number: **NMR05GB21**

Note: Read Instructions before completing this Form.

B. Facility Information

1. Facility Name: **Los Alamos National Laboratory**

2. Facility Location:

a. Street: **Bikini Atoll Rd. SMBB K490**

b. City: **Los Alamos**

c. State: **NM** d. Zip Code: **87545**

3. Additional Facility Information (Optional):

Contact Name: **Anthony Grieggs**

Email: **agrieggst@lanl.gov**

Phone: **505-665-0451** Ext.

4. MDMR Preparer (Complete if MDMR was prepared by someone other than the person signing the certification in Section F)

Prepared by: **Timothy Zimmerly**

Organization: **ENV-RCRA**

Email: **tzimmer@lanl.gov**

Phone: **505-664-0105** Ext.

C. Discharge Information

1. Identify monitoring period:

Check here if proposing alternative monitoring periods due to irregular stormwater runoff. Identify alternative monitoring schedule and indicate for which alternative monitoring period you are reporting monitoring data:

- Quarter 1 (April 1 - June 30) Quarter 1: From **04/01** To **05/31**
- Quarter 2 (July 1 - September 30) Quarter 2: From **06/01** To **07/31**
- Quarter 3 (October 1 - December 31) Quarter 3: From **08/01** To **09/30**
- Quarter 4 (January 1 - March 31) Quarter 4: From **10/01** To **11/30**

2. Are you required to monitor for cadmium, copper, chromium, lead, nickel, silver, or zinc? Yes (Complete line item 2.a.) No (Skip to Section D)

2a. What is the hardness level of the receiving water? **113** mg/L

D. Outfall Information

1. How many outfall(s) are identified in your SWPPP? **24** List name of outfall(s) required to be monitored in table below.

2. Do any of your outfalls discharge substantially identical effluents? YES NO

2.a. If yes, for each monitored outfall, indicate outfall names that are substantially identical in table below.

3.A. Monitored Outfall Name*	3.B. Substantially Identical Outfalls (List name(s) of outfall(s) substantially identical to outfall in 3.A. (if applicable))	3.C. No Discharge?
14-OBOD-1		<input type="checkbox"/>
15-PHRMX-1		<input checked="" type="checkbox"/>
16-OBOD-1		<input type="checkbox"/>
3-MFS-1		<input checked="" type="checkbox"/>
3-MST-1		<input checked="" type="checkbox"/>

*Reference attachment if additional space needed to complete the table.

D. Outfall Information (continued)

3.A. Monitored Outfall Name	3.B. Substantially Identical Outfalls [List name(s) of outfalls substantially identical to outfall in 3.A. (if applicable)]	3.C. No Discharge?
3-PSP-5	3-PSP-1, 3-PSP-2, 3-PSP-3, 3-PSP-4, 3-PSP-6, 3-PSP-7, 3-PSP-8	<input checked="" type="checkbox"/>
3-Sigma-6	3-Sigma-1, 3-Sigma-2, 3-Sigma-3, 3-Sigma-4, 3-Sigma-5, 3-Sigma-7	<input checked="" type="checkbox"/>
3-TS-1		<input checked="" type="checkbox"/>
36-OBOD-1		<input type="checkbox"/>
39-57-OBOD-1		<input checked="" type="checkbox"/>
39-6-OBOD-1		<input checked="" type="checkbox"/>
50-WCRRF-1		<input type="checkbox"/>
54-G-1		<input checked="" type="checkbox"/>
54-G-2	54-G-2a, 54-G-2b	<input checked="" type="checkbox"/>
54-G-3		<input checked="" type="checkbox"/>
54-G-4	54-G-4a, 54-G-4b, 54-G-4c, 54-G-4d, 54-G-4e	<input type="checkbox"/>
54-L-1		<input checked="" type="checkbox"/>
54-RANT-1	54-RANT-1a, 54-RANT-1b	<input checked="" type="checkbox"/>
55-PF-1	55-PF-2	<input checked="" type="checkbox"/>
60-ABP -1		<input checked="" type="checkbox"/>
60-HEY-1	60-HEY-2, 60-HEY-3, 60-HEY-4, 60-HEY-5, 60-HEY-6	<input type="checkbox"/>
60-MRF-1		<input checked="" type="checkbox"/>
60-RG-3	60-RG-1, 60-RG-2, 60-RG-4, 60-RG-5, 60-RG-6, 60-RG-7	<input type="checkbox"/>
60-WH-1	60-WH-2, 60-WH-3	<input type="checkbox"/>

Quarterly analytical monitoring was not performed at 60-HEY-1, 60-RG-3, and 60-WH-1 since these locations are under Sector P and do not require quarterly analytical monitoring under the MSGP. Discharge at these locations was inspected for quarterly visual assessments.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460
MSGP INDUSTRIAL DISCHARGE MONITORING REPORT (IDMR)

Form Approved, OMB No. 2040-0004

E. Monitoring Information

Note: Make additional copies of this form as necessary.

1. Permit Tracking Number: **NM1015GB211**

2. Nature of Discharge: Rainfall (Complete line items 2.a., 2.b., & 2.c.) Snowmelt

2.a. Duration of the rainfall event (hours):

2.b. Rainfall amount (inches):

2.c. Time since previous measurable storm event (days):

3.a. Outfall Name	3.b. Monitoring Type (QBM, ELG, S/T, I, O)	3.c. Parameter	3.d. Quality or Concentration	3.e. Units	3.f. Results-Description	3.g. Collection Date	3.h. Exceedences due to natural background pollutant levels	3.i. No further pollutant reductions achievable?
14-OBOD-1	QBM	Ammonia, total	.224	mg/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
14-OBOD-1	QBM	Arsenic, total	2.1	ug/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
14-OBOD-1	QBM	Cadmium, total	.22	ug/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
14-OBOD-1	QBM	Chemical Oxygen Demand (COD)	ND		5 mg/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
14-OBOD-1	QBM	Cyanide, total	ND		.00166 mg/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
14-OBOD-1	QBM	Lead, total	5.9	ug/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
14-OBOD-1	QBM	Magnesium, total	1.6	mg/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
14-OBOD-1	QBM	Mercury, total	ND		.067 ug/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
14-OBOD-1	QBM	Selenium, total	ND		1 ug/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
14-OBOD-1	QBM	Silver, total	ND		.2 ug/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>

* (QBM) - Quarterly benchmark monitoring; (ELG) - Annual effluent limitations guidelines monitoring; (S/T) - State- or Tribal-specific monitoring; (I) - Impaired waters monitoring; (O) - Other monitoring as required by EPA

4. Comment and/or Explanation of Any Violations (Reference all attachments here)

F. Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Anthony Grieggs,
Group Leader

Typed or Printed Name, Title of Principal Executive Officer or Authorized Agent

Anthony Grieggs
DGL

Signature of Principal Executive Officer or Authorized Agent

7/16/09

Date

Email of Principal Executive Officer or Authorized Agent: grleggs@lanl.gov



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460
MSGP INDUSTRIAL DISCHARGE MONITORING REPORT (MDMR)

Form Approved, OMB No. 2040-0004

E. Monitoring Information

Note: Make additional copies of this form as necessary.

1. Permit Tracking Number: NMR05GB21

2. Nature of Discharge: Rainfall (Complete line items 2.a., 2.b., & 2.c.) Snowmelt

2.a. Duration of the rainfall event (hours):

2.b. Rainfall amount (inches):

2.c. Time since previous measurable storm event (days):

3.a. Outfall Name	3.b. Monitoring Type (QBM, ELG, ST, I, O)	3.c. Parameter	3.d. Quality or Concentration	3.e. Units	3.f. Results Description	3.g. Collector Date	3.h. Exceedance due to natural background pollutant levels	3.i. No further pollutant reductions achievable?
36-OBOD-1	QBM	Ammonia, total	.401	mg/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
36-OBOD-1	QBM	Arsenic, total	ND		1.5 ug/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
36-OBOD-1	QBM	Cadmium, total	.2	ug/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
36-OBOD-1	QBM	Chemical Oxygen Demand (COD)	ND		5 mg/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
36-OBOD-1	QBM	Cyanide, total	ND		.00166 mg/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
36-OBOD-1	QBM	Lead, total	9.7	ug/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
36-OBOD-1	QBM	Magnesium, total	1.33	mg/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
36-OBOD-1	QBM	Mercury, total	ND		.067 ug/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
36-OBOD-1	QBM	Selenium, total	ND		1 ug/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
36-OBOD-1	QBM	Silver, total	ND		.2 ug/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>

* (QBM) - Quarterly benchmark monitoring; (ELG) - Annual effluent limitations guidelines monitoring; (ST) - State- or Tribal-specific monitoring; (I) - Impaired waters monitoring as required by EPA

4. Comment and/or Explanation of Any Violations (Reference all attachments here)

F. Certification

I certify, under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Anthony Grieggs,
Group Leader

Typed or Printed Name/Title of Principal Executive Officer or Authorized Agent

Email of Principal Executive Officer or Authorized Agent: grieggs@lanl.gov

Anthony Grieggs
Signature of Principal Executive Officer or Authorized Agent

7/16/09

Date



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460
MSGP INDUSTRIAL DISCHARGE MONITORING REPORT (IDMR)

Form Approved OMB No. 2040-0004

E. Monitoring Information

Note: Make additional copies of this form as necessary.

1. Permit Tracking Number: **NMRO5GB211**

2. Nature of Discharge: Rainfall (Complete line items 2.a., 2.b., & 2.c.) Snowmelt

2.a. Duration of the rainfall event (hours):

2.b. Rainfall amount (inches):

2.c. Time since previous measurable storm event (days):

3.a. Outfall Name	3.b. Monitoring Type (QBM, ELG, S/T, N, O)*	3.c. Parameter	3.d. Quality or Concentration	3.e. Units	3.f. Results Description	3.g. Collection Date	3.h. Exceedence due to natural background pollutant levels	3.i. No further pollutant reductions achievable?
54-G-4	QBM	Ammonia, total	.045	mg/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
54-G-4	QBM	Arsenic, total	ND		1.5 ug/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
54-G-4	QBM	Cadmium, total	.52	ug/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
54-G-4	QBM	Chemical Oxygen Demand (COD)	81.1	mg/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
54-G-4	QBM	Cyanide, total	ND		.00166 mg/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
54-G-4	QBM	Iron, total	2960	ug/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
54-G-4	QBM	Lead, total	5.8	ug/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
54-G-4	QBM	Magnesium, total	1.35	mg/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
54-G-4	QBM	Mercury, total	ND		.067 ug/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
54-G-4	QBM	Selenium, total	ND		1 ug/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
54-G-4	QBM	Silver, total	ND		.2 ug/L	17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>
54-G-4	QBM	Total Suspended Solids (TSS)	114	mg/L		17-Apr-09	<input type="checkbox"/>	<input type="checkbox"/>

4. Comment and/or Explanation of Any Violations (Reference all attachments here)
 *(QBM) - Quarterly benchmark monitoring; (ELG) - Annual effluent limitations guidelines monitoring; (S/T) - State- or Tribal-specific monitoring; (V) - Impaired waters monitoring; (O) - Other monitoring as required by EPA

F. Certification

Anthony Grieggs,
Group Leader

Typed or Printed Name/Title of Principal Executive Officer or Authorized Agent

Email of Principal Executive Officer or Authorized Agent: **grieggsa@lanl.gov**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Anthony Grieggs

Signature of Principal Executive Officer or Authorized Agent

Date

7/16/09

ENCLOSURE 3

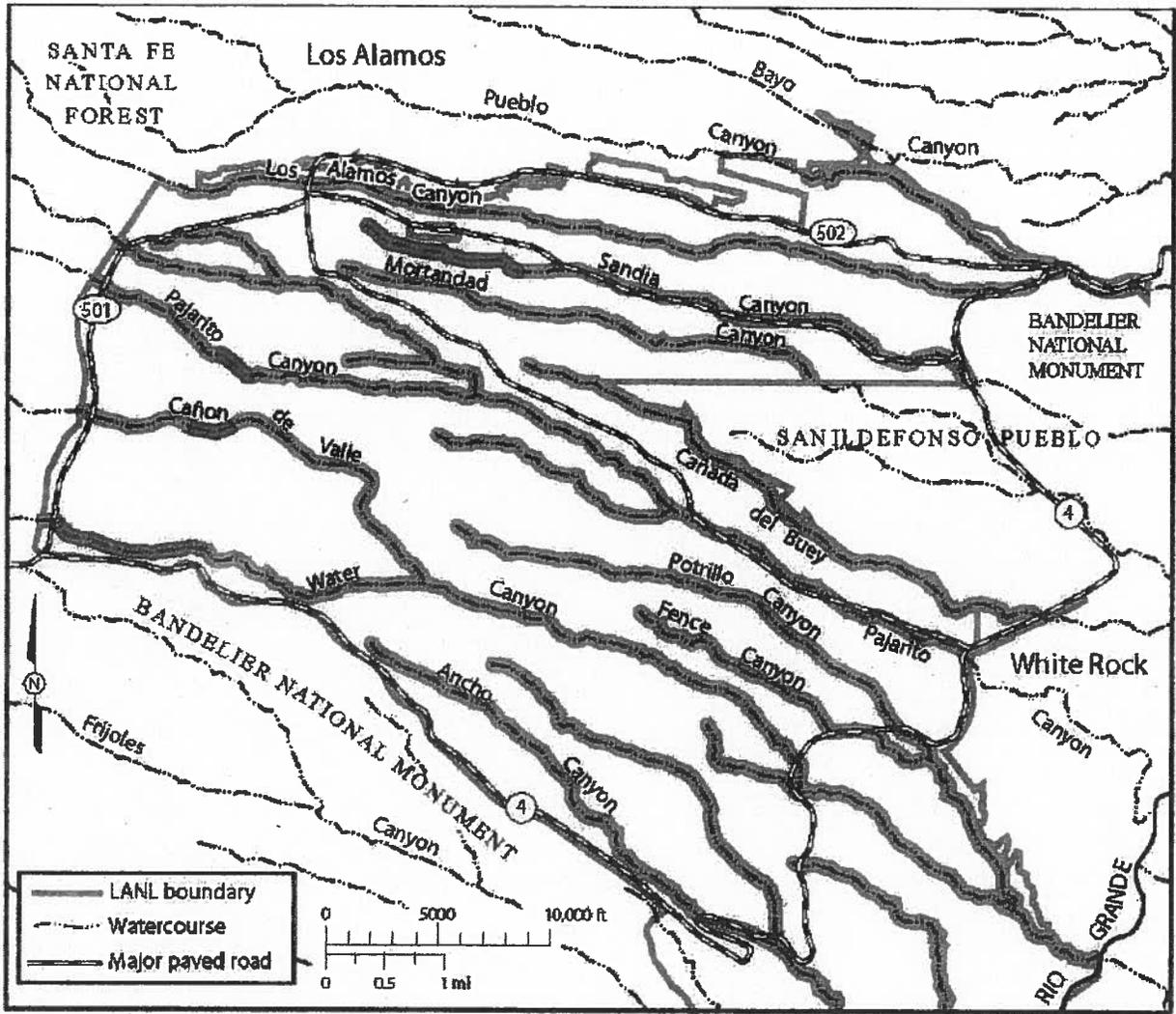
Determination of Hardness of Receiving Waters near the Pajarito Plateau to Determine Benchmark Values for Hardness-Dependent Metals

Identification of Receiving Waters

Los Alamos National Laboratory (LANL) includes parts or all of seven primary watersheds that drain directly into the Rio Grande, each defined by a master canyon (Figure 1). Listed from north to south, the master canyons for these watersheds are Los Alamos, Sandia, Mortandad, Pajarito, Water, Ancho, and Chaquehui Canyons. Each of these canyons includes tributary canyons of various sizes. Three of the primary watersheds have their headwaters west of the Laboratory in the eastern Jemez Mountains (the Sierra de los Valles), mostly within the Santa Fe National Forest (Los Alamos, Pajarito, and Water Canyons), and the remainder head on the Pajarito Plateau. Only the Ancho Canyon watershed is entirely located on Laboratory land. Canyons draining Laboratory property are dry for most of the year, and no perennial surface water extends completely across Laboratory land in any canyon. Approximately two miles of canyon on the Laboratory land have naturally perennial streams fed by springs and approximately three miles have perennial streams created by effluent discharges.

Designated uses and water quality standards are established for particular stream segments in the *State of New Mexico Standards for Interstate and Intrastate Surface Waters* (20.6.4 NMAC). Stream segments within the LANL boundary are classified under two sections of 20.6.4 NMAC: Perennial portions classified as NM 20.6.4.126, and ephemeral or intermittent portions, classified as NM 20.6.4.128 (Figure 1).

On Laboratory land, six MSGP-permitted facilities discharge stormwater runoff to minor drainages of an effluent-dominated perennial stream in Sandia Canyon (NM 20.6.4.126) created by effluent discharges from NPDES Outfalls 001, 13S, 03A027 and 03A199. These NPDES-permitted discharges consist primarily of cooling tower discharge and treated sanitary effluent authorized and monitored under the Laboratory's permit for industrial point source discharges, NPDES No. NM0028355. The total volume of effluent discharge from these outfalls was approximately 120,000,000 gal. in 2007 (LANL 2008, LA-14369-ENV). All other MSGP-permitted discharges are to ephemeral stream segments (NM 20.6.4.128). The closest naturally occurring perennial stream commonly downstream of all MSGP-permitted points of discharge is the Rio Grande (classified stream segment 20.6.4.114).



Stream Type Designated Uses:

Perennial (NM 20.6.4.126): Coldwater Aquatic Life, Livestock Watering, Wildlife Habitat, Secondary Contact. Ephemeral and Intermittent (NM 20.6.4.128): Limited Aquatic Life, Livestock Watering, Wildlife Habitat, Secondary Contact.

-  Perennial
-  Ephemeral and Intermittent

Figure 1. State of New Mexico Designated Stream Segments and Uses at Los Alamos National Laboratory

Methods (Data Sets) Used to Determine Hardness

Appendix J of the MSGP allows for selection from three methods to determine hardness, including Permittee data, group monitoring, and third party data. Permittee and third party hardness data are available for the Rio Grande; both are presented and evaluated individually herein.

Three data sets are evaluated to derive hardness statistics on the waters of the Rio Grande.

- Rio Grande at Otowi Bridge (third party data set [USGS], containing data collected between 1993 to 2001)
- Rio Grande at Otowi Bridge (third party data set [USGS], limited to data collected within the last 10 years (since 1999))
- Rio Grande from Embudo Crossing to Bernalillo (LANL data set)

USGS data for the Rio Grande was obtained from the National Water Quality Assessment Data Warehouse at <http://infotrek.er.usgs.gov/traverse/?p=NAWQA:HOME:1191795418273673>.

The USGS data set reports individual results for calcium (Ca) and magnesium (Mg). Hardness is calculated using the following equation:

$$\text{mg/L CaCO}_3 = 2.97 (\text{Ca mg/L}) + 4.118 (\text{Mg mg/L})$$

The LANL data set reports results for measured hardness.

Calculations

NPDES regulations at 40 CFR 122.33(d)(1)(ii) requires a permitting authority to account for effluent variability when determining whether a discharge causes, has reasonable potential to cause, or contributes to an instream excursion above a water quality standard. The Region 6 implementation Guidance for State of New Mexico Standards for Interstate and Intrastate Streams (EPA, 1995) states that variability will be accounted for "by employing the statistical multiplier of 2.13 (and estimate of the 95th percentile) for either a single available effluent concentration, or a geometric mean of effluent data concentration. Storm water data often is log-normally distributed and the geometric mean is the most statistically robust estimate of central tendency.

Each data set was assessed for normality using a series of standard tests. Generally, normality tests have a lower probability of detecting non-normal data unless the sample sizes are large (e.g., over 100). The Shapiro-Wilk W test has been found to be the most powerful test in most situations, and more sensitive for determining the normality of distributions of small sample size (less than or equal to 50). The results of the Shapiro-Wilk W test indicate non-normal distributions for two of the data sets: Rio Grande at Otowi Bridge (USGS data set 1993 to 2001) and Rio Grande from Embudo to Bernalillo (LANL data set). These non-normal distributions were prepared for statistical evaluation by calculating the Alpha T2 probability to identify outliers, which were then excluded to achieve a normally distributed data set prior to performing statistical analysis.

Statistical summaries of the data are presented in Figure 2 and Table 1. Descriptive statistics reports are presented in Attachment 1 and data sets are presented in Attachment 2.

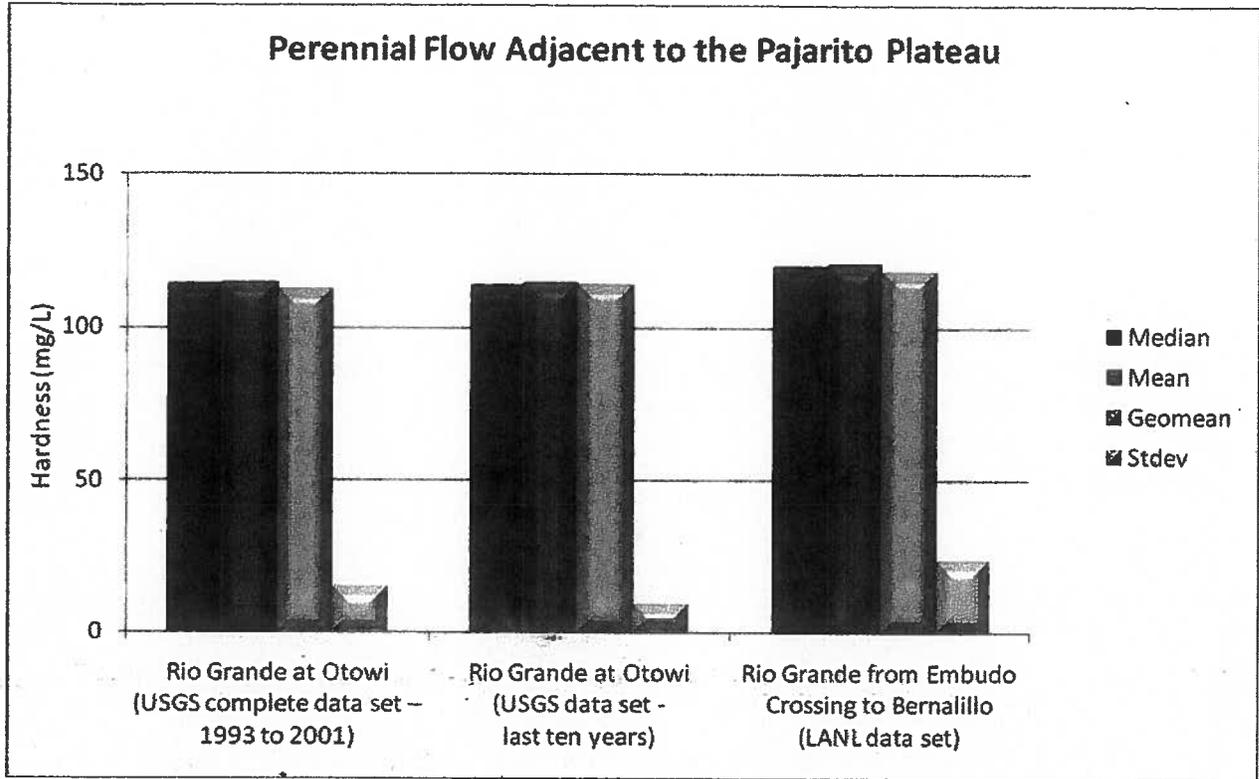


Figure 2. Statistical summary of hardness results for the Rio Grande

Table 1.
Statistical Summary of Hardness Results for the Rio Grande

Sample Collection Location	Min	Max	Median	Mean	Geomean	Stdev	95% LCL	95 th percentile	95% UCL	n	Outliers excluded (T2)
Rio Grande at Otowi (USGS complete data set – 1993 to 2001)	85.1	138.7	114.3	114.4	112.5	15.1	-	137.2	-	32	2
Rio Grande at Otowi (USGS data set, < 10 years old)	104.3	126.8	113.6	114.4	114	9.3	-	126.8	-	4	0
Rio Grande from Embudo Crossing to Bernalillo (LANL data set)	63.5	180	120	120.8	118.4	23.6	153	162.7	168	228	8

- Not calculated due to small sample size

Geomean calculations for each of the three data sets range from 112.5 to 118.4, which fall within the 25 mg/L range of 100 to 125 mg/L. The corresponding benchmark values for hardness dependent metals are presented in Table 2. These values will be used for evaluation of benchmark monitoring data where applicable.

Table 2.
Benchmark Values for Cadmium, Copper, Lead, Nickel, Silver, and Zinc
Corresponding to the Hardness Range of 100-125 mg/L

Hardness Range	Benchmark Values (mg/L, total)					
	Cadmium	Copper	Lead	Nickel	Silver	Zinc
100-125 mg/L	0.0023	0.0156	0.095	0.52	0.0046	0.13

[from Appendix J of the 2008 MSGP, (EPA 2008)]

References:

EPA (Environmental Protection Agency), September 2008, "Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity (MSGP)," Environmental Protection Agency. (EPA 2008)

LANL (Los Alamos National Laboratory), September 2008, "Environmental Surveillance at Los Alamos during 2007," Los Alamos National Laboratory Report LA-14369-ENV, Los Alamos, New Mexico. (LANL 2008, LA-14369-ENV)

Descriptive Statistics Report of Results for Rio Grande at Otowi Bridge (USGS complete 1993-2001 data set)

Summary

Count	Mean	Standard Deviation	Standard Error	Minimum	Maximum	Range
32	114.3875	12.74954	2.253822	85.1	138.7	53.6

Means

Parameter	Mean	Median	Geometric Mean	Harmonic Mean	Sum	Mode
Value	114.3875	114.85	113.6606	112.8901	3660.4	
Std Error	2.253822			72.1223		
95% LCL	109.7908	111.7	108.982	108.1043	3513.306	
95% UCL	118.9842	119.1	118.54	118.1193	3807.494	
T-Value	50.75268					
Prob Level	0					
Count	32	32	32			0

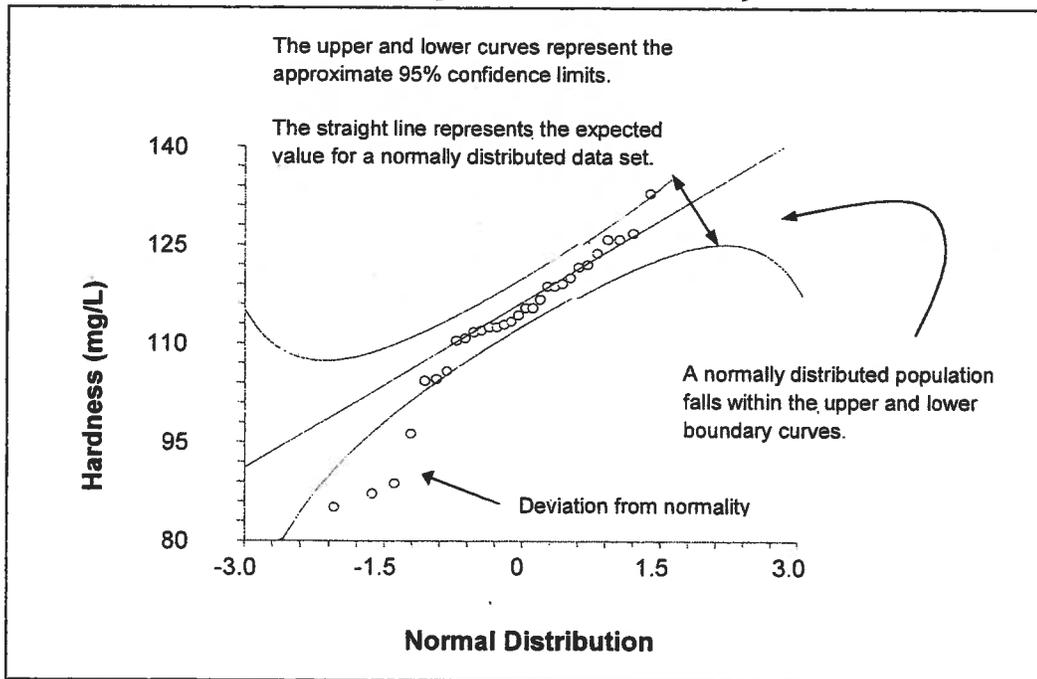
The geometric mean confidence interval assumes that the $\ln(y)$ are normally distributed.
 The harmonic mean confidence interval assumes that the $1/y$ are normally distributed.

Normality Test Section

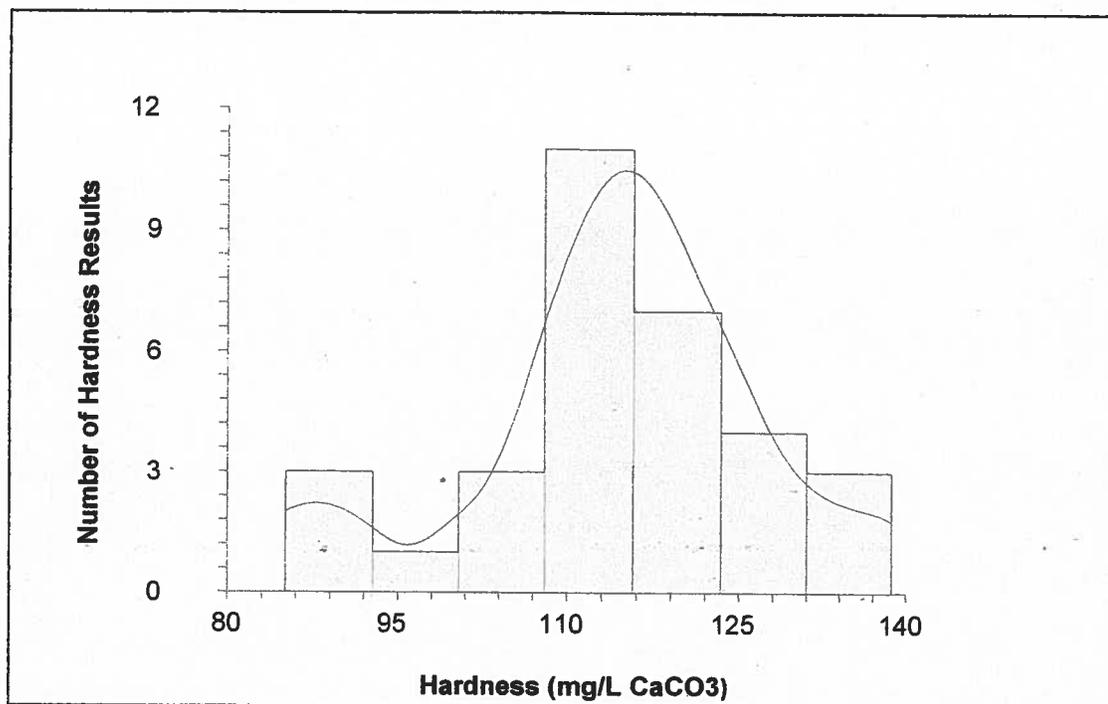
Test Name	Test Value	Prob Level	10% Critical Value	5% Critical Value	Decision (5%)
Shapiro-Wilk W	0.950574	0.1496333			Can't reject normality
Anderson-Darling	0.6313467	9.993409E-02			Can't reject normality
Martinez-Iglewicz	1.124092		1.140086	1.214189	Can't reject normality
Kolmogorov-Smirnov	0.1272329		0.142	0.154	Can't reject normality
D'Agostino Skewness	-1.315342	0.1883951	1.645	1.960	Can't reject normality
D'Agostino Kurtosis	0.8947	0.370953	1.645	1.960	Can't reject normality
D'Agostino Omnibus	2.5306	0.282156	4.605	5.991	Can't reject normality

Plots Section

Normal probability plot of hardness at Rio Grande at Otowi Bridge (USGS complete 1993-2001 data set)



**Histogram of hardness at Rio Grande at Otowi Bridge
 (USGS complete 1993-2001 data set)**



Percentile Section

Percentile	Value	95% LCL	95% UCL	Exact Conf. Level
99	138.7			
95	137.335			
90	131.07	122	138.7	95.39777
85	125.85	121.6	138.7	95.31888
80	124.54	118.7	132.9	95.15925
75	121.9	116.7	126.8	95.8974
70	120.16	115.4	125.8	96.7281
65	118.88	113.3	123.7	95.25375
60	118.3	112.9	122	95.42965
55	115.595	112.5	121.6	96.86242
50	114.85	111.7	119.1	96.4918
45	113.24	110.8	118.7	96.86242
40	112.58	110.4	116.7	95.42965
35	112.275	104.6	115.4	95.9624
30	111.61	96.3	113.3	96.17956
25	110.5	88.8	112.5	95.55407
20	105.32	87.2	112	95.17812
15	103.9	85.1	110.8	95.31888
10	91.05	85.1	110.4	95.39777
5	86.465			
1	85.1			

Percentile Formula: Ave X(p[n+1])

Descriptive Statistics Report of Results for Rio Grande at Otowi Bridge (USGS complete 1993-2001 data set)
continued

Multivariate Outlier Section

Row	Value	ln value	T2 Value	T2 Prob	Outlier?
1	74.7	4.313480092	7.57	0.0095	Yes
2	81.8	4.404277244	4.51	0.0413	Yes
3	85.1	4.443827036	3.42	0.0733	
4	87.2	4.468204331	2.83	0.1021	
5	88.8	4.48638665	2.42	0.1294	
6	96.3	4.567468319	0.99	0.3272	
7	104.3	4.647271362	0.2	0.6611	
8	104.6	4.650143552	0.18	0.6754	
9	105.8	4.661550519	0.12	0.7334	
10	110.4	4.704110134	0	0.9612	
11	110.8	4.707726774	0	0.981	
12	111.7	4.715816706	0	0.9747	
13	112	4.718498871	0	0.96	
14	112.5	4.722953222	0.01	0.9357	
15	112.5	4.722953222	0.01	0.9357	
16	112.9	4.726502471	0.01	0.9163	
17	113.3	4.730039168	0.02	0.8971	
18	114.3	4.738826571	0.04	0.8496	
19	115.4	4.748404354	0.07	0.7984	
20	115.4	4.748404354	0.07	0.7984	
21	116.7	4.759606539	0.11	0.7398	
22	118.7	4.776599302	0.2	0.6538	
23	118.7	4.776599302	0.2	0.6538	
24	119.1	4.779963476	0.23	0.6373	
25	120	4.787491743	0.28	0.6011	
26	121.6	4.80073697	0.38	0.5398	
27	122	4.804021045	0.41	0.5251	
28	123.7	4.817859279	0.54	0.4657	
29	125.8	4.834693344	0.73	0.399	
30	125.8	4.834693344	0.73	0.399	
31	126.8	4.842611042	0.83	0.3698	
32	132.9	4.889596966	1.52	0.2258	
33	136.6	4.917056947	2.03	0.1637	
34	138.7	4.932313327	2.34	0.1355	

Descriptive Statistics Report of Results for Rio Grande at Otowi Bridge (USGS data set < 10 years old)

Summary

Count	Mean	Standard Deviation	Standard Error	Minimum	Maximum	Range
4	114.35	9.336844	4.668422	104.3	126.8	22.5

Means

Parameter	Mean	Median	Geometric Mean	Harmonic Mean	Sum	Mode
Value	114.35	113.15	114.0688	113.7927	457.4	
Std Error	4.668422				18.67369	
95% LCL	99.493		100.3183	100.9779	397.972	
95% UCL	129.207		129.7042	130.3328	516.828	
T-Value	24.49436					
Prob Level	1.49167E-04					
Count	4		4	4		0

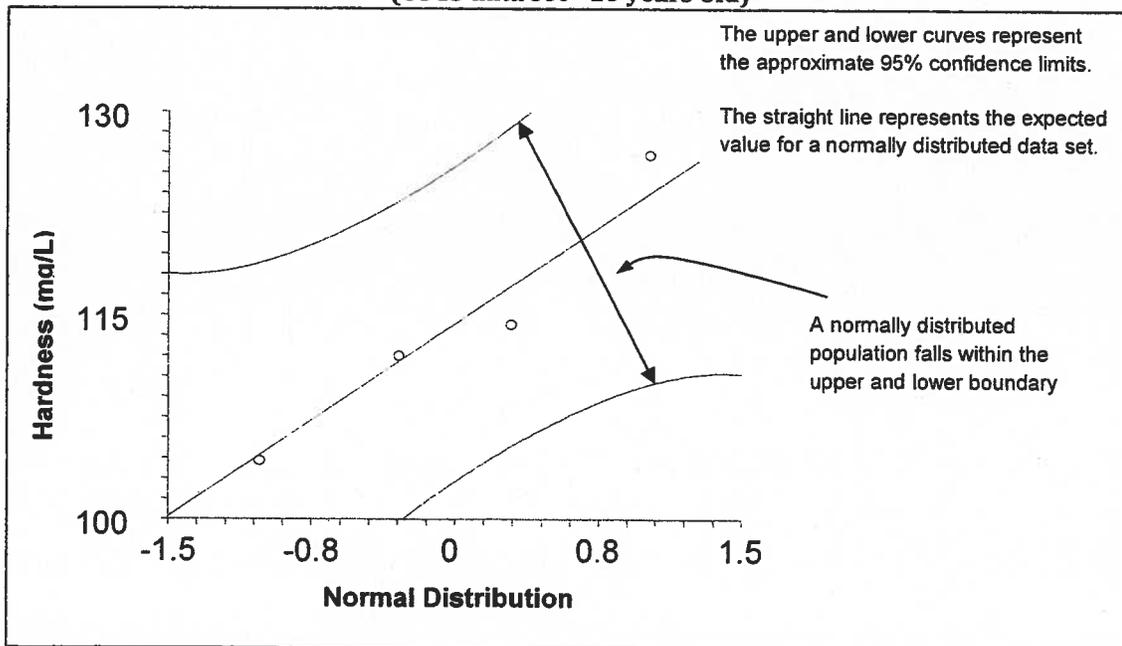
The geometric mean confidence interval assumes that the $\ln(y)$ are normally distributed.
 The harmonic mean confidence interval assumes that the $1/y$ are normally distributed.

Normality Tests

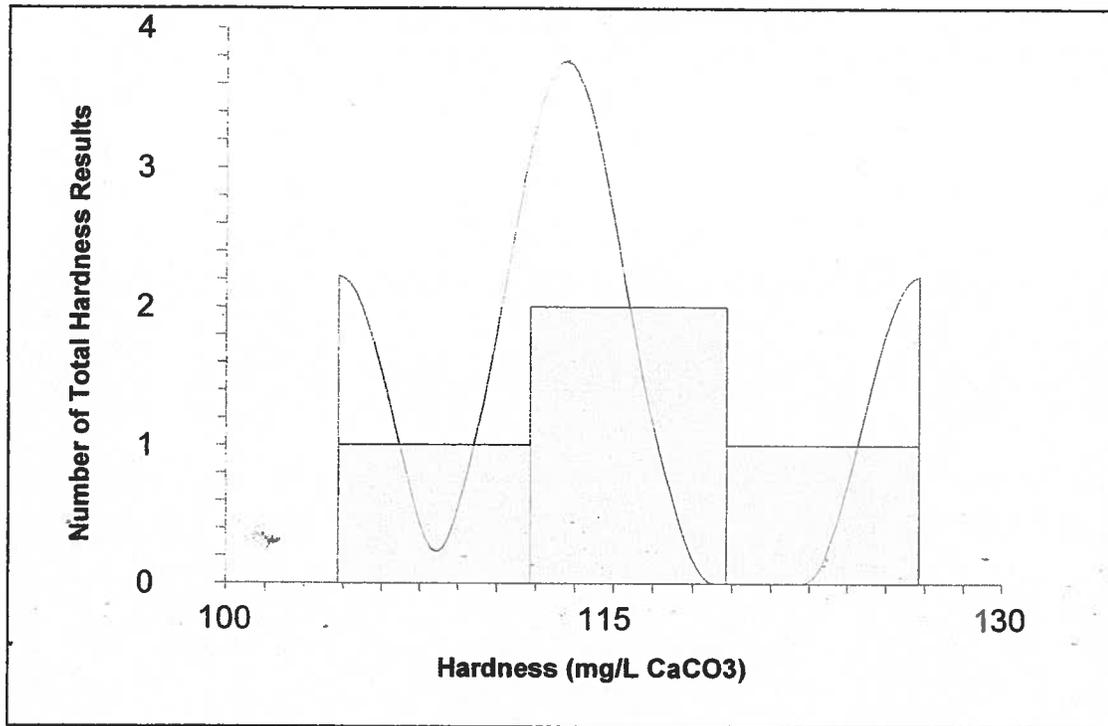
Test Name	Test Value	Prob Level	10% Critical Value	5% Critical Value	Decision (5%)
Shapiro-Wilk W	0.9601054	0.7795721			Can't reject normality
Anderson-Darling					
Martinez-Iglewicz	1.205099		2.288353	7.591605	Can't reject normality
Kolmogorov-Smirnov	0.2521364		0.346	0.376	Can't reject normality
D'Agostino Skewness	0		1.645	1.960	
D'Agostino Kurtosis		1.000000	1.645	1.960	
D'Agostino Omnibus			4.605	5.991	

Plots Section

Normal probability plot of hardness at Rio Grande at Otowi Bridge (USGS data set <10 years old)



**Histogram of hardness at Rio Grande at Otowi Bridge
 (USGS data set <10 years old)**



Percentile Section

Percentile	Value	95% LCL	95% UCL	Exact Conf. Level
99	126.8			
95	126.8			
90	126.8			
85	126.8			
80	126.8			
75	123.675			
70	120.55			
65	117.425			
60	114.3			
55	113.725			
50	113.15			
45	112.575			
40	112			
35	110.075			
30	108.15			
25	106.225			
20	104.3			
15	104.3			
10	104.3			
5	104.3			
1	104.3			

Percentile Formula: Ave X(p[n+1])

Descriptive Statistics Report of Results for Rio Grande from Embudo Crossing to Bernalillo (LANL data set)

Summary

Count	Mean	Standard Deviation	Standard Error	Minimum	Maximum	Range
228	120.7934	23.55987	1.56029	63.5	180	116.5

Means

Parameter	Mean	Median	Geometric Mean	Harmonic Mean	Sum	Mode
Value	120.7934	120	118.4458	116.0253	27540.9	104
Std Error	1.56029				355.7462	
95% LCL	117.7189	116	115.3771	112.9209	26839.91	
95% UCL	123.8679	124	121.5961	119.3053	28241.89	
T-Value	77.41727					
Prob Level	0					
Count	228		228	228		9

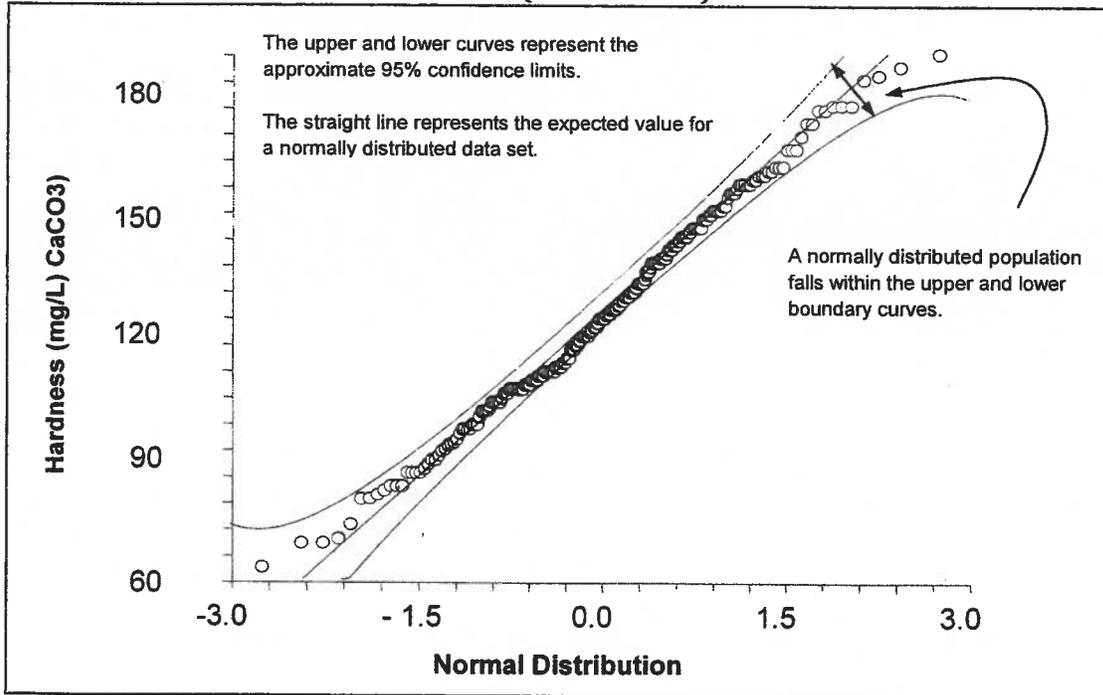
The geometric mean confidence interval assumes that the $\ln(y)$ are normally distributed.
 The harmonic mean confidence interval assumes that the $1/y$ are normally distributed.

Normality Test Section

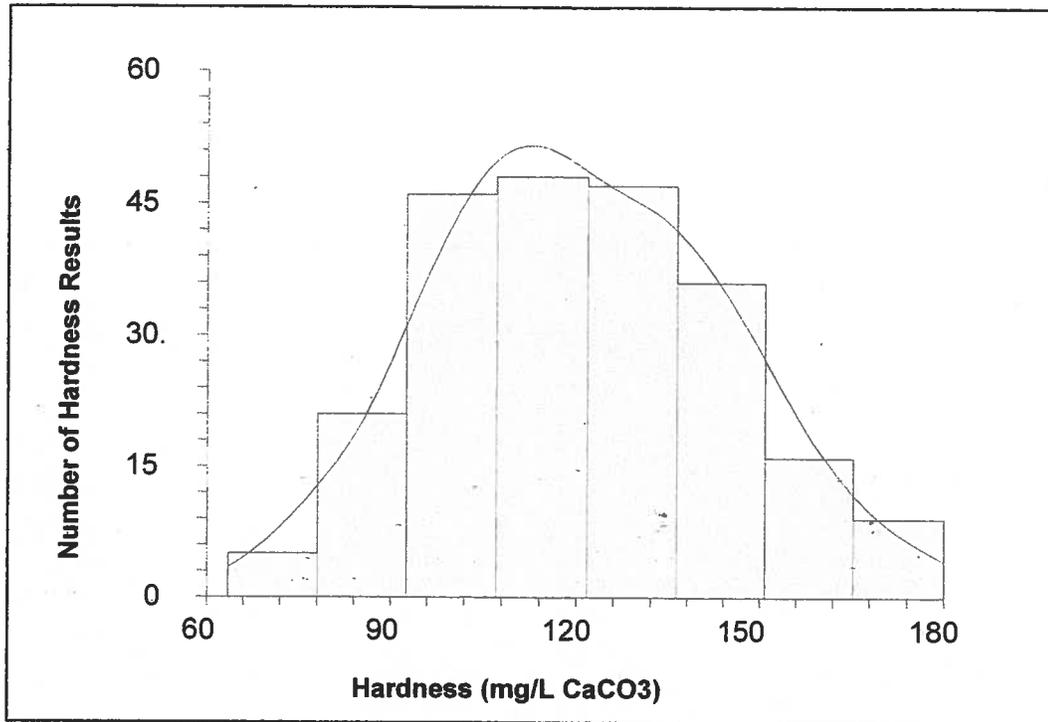
Test Name	Test Value	Prob Level	10% Critical Value	5% Critical Value	Decision (5%)
Shapiro-Wilk W	0.9931286	0.3735384			Can't reject normality
Anderson-Darling	0.4445326	0.284462			Can't reject normality
Martinez-Iglewicz	0.9520729		1.023943	1.038567	Can't reject normality
Kolmogorov-Smirnov	6.008502E-02		0.054	0.059	Reject normality
D'Agostino Skewness	0.7588434	0.4479462	1.645	1.960	Can't reject normality
D'Agostino Kurtosis	-1.4097	0.158618	1.645	1.960	Can't reject normality
D'Agostino Omnibus	2.5632	0.277593	4.605	5.991	Can't reject normality

Plots Section

Normal probability plot of hardness at Rio Grande from Embudo Crossing to Bernalillo (LANL data set)



Histogram of hardness at Rio Grande from Embudo Crossing to Bernalillo (LANL data set)



Percentile Section

Percentile	Value	95% LCL	95% UCL	Exact Conf. Level
99	176.42			
95	162.65	153	168	95.21337
90	152	148	158	95.32624
85	147.65	142	151	95.9304
80	142	138	148	95.34814
75	138	133	142	95.31792
70	133.3	130	139	95.72871
65	130	125	135	95.61621
60	126	122	132	95.01772
55	122.965	119	128	95.43707
50	120	116	124	95.28088
45	116	111	121	95.43707
40	113	108	117	95.01772
35	109	106	114	95.47192
30	106.7	104	109	95.72871
25	104	101	107	95.27689
20	101	96	104	95.34814
15	96	91.3	101	95.9304
10	90.45	85	95	95.32624
5	82	73.2	87.1	95.1267
1	69			

Percentile Formula: Ave X(p[n+1])

***Descriptive Statistics Report of Results for Rio Grande from Embudo Crossing to Bernalillo (LANL data set)
continued***

Multivariate Outlier Section

Row	Value	ln value	T2 Value	T2 Prob	Outlier?
1	4	1.386294361	14.49	0.0002	Yes
2	47.2	3.854393893	5.78	0.017	Yes
3	50	3.912023005	5.35	0.0215	Yes
4	59.5	4.085976313	4.02	0.046	Yes
5	63.5	4.151039906	3.52	0.0619	
6	69	4.234106505	2.88	0.0909	
7	69	4.234106505	2.88	0.0909	
8	70	4.248495242	2.77	0.0972	
9	73.2	4.293195421	2.44	0.1198	
10	79	4.369447852	1.89	0.171	
11	79.1	4.370712875	1.88	0.172	
12	80	4.382026635	1.8	0.1813	
13	81	4.394449155	1.71	0.1921	
14	82	4.406719247	1.63	0.2033	
15	82	4.406719247	1.63	0.2033	
16	82	4.406719247	1.63	0.2033	
17	85	4.442651256	1.39	0.2398	
18	85	4.442651256	1.39	0.2398	
19	85	4.442651256	1.39	0.2398	
20	85.1	4.443827036	1.38	0.2411	
21	86	4.454347296	1.31	0.2529	
22	87.1	4.467056884	1.23	0.268	
23	88	4.477336814	1.17	0.2807	
24	88	4.477336814	1.17	0.2807	
25	89	4.48863637	1.1	0.2954	
26	90	4.49980967	1.03	0.3105	
27	90.5	4.505349851	1	0.3183	
28	91.3	4.514150788	0.95	0.331	
29	91.6	4.517431272	0.93	0.3358	
30	92	4.521788577	0.91	0.3423	
31	92.7	4.529368473	0.86	0.354	
32	94	4.543294782	0.79	0.3762	
33	95	4.553876892	0.73	0.3939	
34	95	4.553876892	0.73	0.3939	
35	95	4.553876892	0.73	0.3939	
36	95	4.553876892	0.73	0.3939	
37	96	4.564348191	0.68	0.4121	
38	96	4.564348191	0.68	0.4121	
39	96	4.564348191	0.68	0.4121	
40	97.8	4.582924577	0.58	0.446	
41	99	4.59511985	0.52	0.4695	
42	99	4.59511985	0.52	0.4695	
43	99.1	4.596129441	0.52	0.4715	
44	99.3	4.598145571	0.51	0.4755	

Descriptive Statistics Report of Results for Rio Grande from Embudo Crossing to Bernalillo (LANL data set)
continued

Row	Value	ln value	T2 Value	T2 Prob	Outlier?
45	100	4.605170186	0.48	0.4896	
46	101	4.615120517	0.44	0.5102	
47	101	4.615120517	0.44	0.5102	
48	101	4.615120517	0.44	0.5102	
49	101	4.615120517	0.44	0.5102	
50	101	4.615120517	0.44	0.5102	
51	102	4.624972813	0.39	0.5312	
52	103	4.634728988	0.35	0.5526	
53	103	4.634728988	0.35	0.5526	
54	103	4.634728988	0.35	0.5526	
55	104	4.644390899	0.32	0.5745	
56	104	4.644390899	0.32	0.5745	
57	104	4.644390899	0.32	0.5745	
58	104	4.644390899	0.32	0.5745	
59	104	4.644390899	0.32	0.5745	
60	104	4.644390899	0.32	0.5745	
61	104	4.644390899	0.32	0.5745	
62	104	4.644390899	0.32	0.5745	
63	104	4.644390899	0.32	0.5745	
64	105	4.65396035	0.28	0.5968	
65	105	4.65396035	0.28	0.5968	
66	105	4.65396035	0.28	0.5968	
67	105	4.65396035	0.28	0.5968	
68	106	4.663439094	0.25	0.6194	
69	106	4.663439094	0.25	0.6194	
70	106	4.663439094	0.25	0.6194	
71	106	4.663439094	0.25	0.6194	
72	106	4.663439094	0.25	0.6194	
73	107	4.672828834	0.22	0.6424	
74	107	4.672828834	0.22	0.6424	
75	107	4.672828834	0.22	0.6424	
76	107	4.672828834	0.22	0.6424	
77	108	4.682131227	0.19	0.6658	
78	108	4.682131227	0.19	0.6658	
79	108	4.682131227	0.19	0.6658	
80	108	4.682131227	0.19	0.6658	
81	108	4.682131227	0.19	0.6658	
82	108	4.682131227	0.19	0.6658	
83	108	4.682131227	0.19	0.6658	
84	109	4.691347882	0.16	0.6895	
85	109	4.691347882	0.16	0.6895	
86	109	4.691347882	0.16	0.6895	
87	109	4.691347882	0.16	0.6895	
88	109	4.691347882	0.16	0.6895	
89	110	4.700480366	0.14	0.7135	

***Descriptive Statistics Report of Results for Rio Grande from Embudo Crossing to Bernalillo (LANL data set)
continued***

Row	Value	ln value	T2 Value	T2 Prob	Outlier?
90	110	4.700480366	0.14	0.7135	
91	110	4.700480366	0.14	0.7135	
92	111	4.709530201	0.11	0.7378	
93	111	4.709530201	0.11	0.7378	
94	111	4.709530201	0.11	0.7378	
95	113	4.727387819	0.07	0.7872	
96	113	4.727387819	0.07	0.7872	
97	113	4.727387819	0.07	0.7872	
98	114	4.736198448	0.06	0.8122	
99	114	4.736198448	0.06	0.8122	
100	114	4.736198448	0.06	0.8122	
101	115	4.744932128	0.04	0.8374	
102	115	4.744932128	0.04	0.8374	
103	116	4.753590191	0.03	0.8628	
104	116	4.753590191	0.03	0.8628	
105	116	4.753590191	0.03	0.8628	
106	116	4.753590191	0.03	0.8628	
107	116	4.753590191	0.03	0.8628	
108	116	4.753590191	0.03	0.8628	
109	117	4.762173935	0.02	0.8883	
110	117	4.762173935	0.02	0.8883	
111	117.5	4.766438334	0.02	0.9012	
112	118	4.770684624	0.01	0.914	
113	118	4.770684624	0.01	0.914	
114	118	4.770684624	0.01	0.914	
115	119	4.779123493	0.01	0.9397	
116	120	4.787491743	0	0.9655	
117	120	4.787491743	0	0.9655	
118	120	4.787491743	0	0.9655	
119	120	4.787491743	0	0.9655	
120	120	4.787491743	0	0.9655	
121	120.8	4.794136286	0	0.9862	
122	121	4.795790546	0	0.9914	
123	121	4.795790546	0	0.9914	
124	121	4.795790546	0	0.9914	
125	122	4.804021045	0	0.9828	
126	122	4.804021045	0	0.9828	
127	122	4.804021045	0	0.9828	
128	122	4.804021045	0	0.9828	
129	122.3	4.806477043	0	0.975	
130	123	4.812184355	0	0.9569	
131	123	4.812184355	0	0.9569	
132	124	4.820281566	0.01	0.9311	
133	124	4.820281566	0.01	0.9311	
134	124	4.820281566	0.01	0.9311	

Descriptive Statistics Report of Results for Rio Grande from Embudo Crossing to Bernalillo (LANL data set)
continued

Row	Value	ln value	T2 Value	T2 Prob	Outlier?
135	125	4.828313737	0.01	0.9054	
136	125	4.828313737	0.01	0.9054	
137	125	4.828313737	0.01	0.9054	
138	125	4.828313737	0.01	0.9054	
139	126	4.836281907	0.02	0.8798	
140	126	4.836281907	0.02	0.8798	
141	126	4.836281907	0.02	0.8798	
142	126	4.836281907	0.02	0.8798	
143	127	4.844187086	0.03	0.8543	
144	128	4.852030264	0.05	0.829	
145	128	4.852030264	0.05	0.829	
146	128	4.852030264	0.05	0.829	
147	128	4.852030264	0.05	0.829	
148	128	4.852030264	0.05	0.829	
149	129	4.859812404	0.06	0.8038	
150	130	4.86753445	0.08	0.7789	
151	130	4.86753445	0.08	0.7789	
152	130	4.86753445	0.08	0.7789	
153	130	4.86753445	0.08	0.7789	
154	131	4.875197323	0.1	0.7541	
155	132	4.882801923	0.12	0.7296	
156	132	4.882801923	0.12	0.7296	
157	132	4.882801923	0.12	0.7296	
158	132	4.882801923	0.12	0.7296	
159	132	4.882801923	0.12	0.7296	
160	132	4.882801923	0.12	0.7296	
161	133	4.890349128	0.14	0.7054	
162	133	4.890349128	0.14	0.7054	
163	133	4.890349128	0.14	0.7054	
164	133	4.890349128	0.14	0.7054	
165	134	4.8978398	0.17	0.6815	
166	135	4.905274778	0.2	0.6579	
167	135	4.905274778	0.2	0.6579	
168	135	4.905274778	0.2	0.6579	
169	136	4.912654886	0.23	0.6347	
170	136	4.912654886	0.23	0.6347	
171	136	4.912654886	0.23	0.6347	
172	137	4.919980926	0.26	0.6118	
173	137	4.919980926	0.26	0.6118	
174	138	4.927253685	0.29	0.5893	
175	138	4.927253685	0.29	0.5893	
176	138	4.927253685	0.29	0.5893	
177	138	4.927253685	0.29	0.5893	
178	139	4.934473933	0.33	0.5671	
179	139	4.934473933	0.33	0.5671	

***Descriptive Statistics Report of Results for Rio Grande from Embudo Crossing to Bernalillo (LANL data set)
continued***

Row	Value	ln value	T2 Value	T2 Prob	Outlier?
180	140	4.941642423	0.37	0.5454	
181	140	4.941642423	0.37	0.5454	
182	140	4.941642423	0.37	0.5454	
183	140	4.941642423	0.37	0.5454	
184	140	4.941642423	0.37	0.5454	
185	140	4.941642423	0.37	0.5454	
186	142	4.955827058	0.45	0.5033	
187	142	4.955827058	0.45	0.5033	
188	142	4.955827058	0.45	0.5033	
189	143	4.96284463	0.49	0.4829	
190	143	4.96284463	0.49	0.4829	
191	144	4.9698133	0.54	0.4629	
192	144	4.9698133	0.54	0.4629	
193	144	4.9698133	0.54	0.4629	
194	144	4.9698133	0.54	0.4629	
195	144	4.9698133	0.54	0.4629	
196	145	4.976733742	0.59	0.4434	
197	145	4.976733742	0.59	0.4434	
198	147	4.990432587	0.69	0.4059	
199	148	4.997212274	0.75	0.3879	
200	148	4.997212274	0.75	0.3879	
201	148	4.997212274	0.75	0.3879	
202	149	5.003946306	0.81	0.3704	
203	150	5.010635294	0.86	0.3534	
204	150	5.010635294	0.86	0.3534	
205	150	5.010635294	0.86	0.3534	
206	150	5.010635294	0.86	0.3534	
207	150	5.010635294	0.86	0.3534	
208	151	5.017279837	0.93	0.3369	
209	151	5.017279837	0.93	0.3369	
210	152	5.023880521	0.99	0.3209	
211	152	5.023880521	0.99	0.3209	
212	152	5.023880521	0.99	0.3209	
213	153	5.030437921	1.06	0.3054	
214	153	5.030437921	1.06	0.3054	
215	154	5.036952602	1.12	0.2904	
216	154	5.036952602	1.12	0.2904	
217	154	5.036952602	1.12	0.2904	
218	158	5.062595033	1.41	0.2355	
219	158	5.062595033	1.41	0.2355	
220	158	5.062595033	1.41	0.2355	
221	161	5.081404365	1.66	0.1995	
222	164	5.099866428	1.92	0.1677	
223	164	5.099866428	1.92	0.1677	
224	167	5.117993812	2.19	0.1399	

Descriptive Statistics Report of Results for Rio Grande from Embudo Crossing to Bernalillo (LANL data set)
continued

Row	Value	ln value	T2 Value	T2 Prob	Outlier?
225	167	5.117993812	2.19	0.1399	
226	168	5.123963979	2.29	0.1314	
227	168	5.123963979	2.29	0.1314	
228	168	5.123963979	2.29	0.1314	
229	174	5.159055299	2.92	0.0889	
230	175	5.164785974	3.03	0.083	
231	177	5.176149733	3.26	0.0722	
232	180	5.192956851	3.62	0.0583	
233	183	5.209486153	4	0.0466	Yes
234	195	5.272999559	5.71	0.0177	Yes
235	203	5.313205979	7.02	0.0086	Yes
236	352	5.863631176	55.98	0	Yes

Hardness Results for the Rio Grande at Otowi (USGS complete data set - 1993 to 2001)

County	Suid	Staid	Place Name	Land Use	Total area sq.mi.	Huc	Sample Medium Desc	Sample Type	Result Datetime	Calcium_wf	Magnesium_wf	Hardness mg/L CaCO3
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	3/17/1993 9:30	34	6.3	110.8
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	4/20/1993 13:45	35	7.6	118.7
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	6/23/1993 8:30	26	5.4	87.2
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	7/27/1993 9:00	37	7.2	122.0
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	8/24/1993 8:30	41	7.4	132.9
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	9/21/1993 10:00	36	6.5	116.7
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	10/19/1993 9:30	38	7.5	125.8
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	11/18/1993 10:00	38	7.5	125.8
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	12/14/1993 9:30	34	6.8	112.9
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	1/13/1994 11:30	34	6.5	111.7
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	2/23/1994 8:15	35	6.8	115.4
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	3/22/1994 9:30	32	6	104.6
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	4/21/1994 8:30	29	5.8	96.3
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	5/23/1994 13:45	25	4.7	81.8
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	6/8/1994 10:00	26	4.9	85.1
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	7/19/1994 10:30	34	6.7	112.5
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	8/9/1994 9:15	35	6.8	115.4
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	9/7/1994 8:30	43	7.6	138.7
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	10/6/1994 8:15	37	6.7	120.0
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	11/14/1994 11:00	42	7.7	136.6
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	12/6/1994 8:15	38	7	123.7
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	1/24/1995 9:00	35	6.3	113.3
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	2/15/1995 10:15	34	6.2	110.4
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	3/16/1995 8:30	36	7	118.7
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	4/18/1995 8:15	32	6.3	105.8
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	5/16/1995 11:00	27	5.2	88.8
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	6/21/1995 10:45	23	4.2	74.7
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	7/26/1995 11:00	36	7.1	119.1
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	8/22/1995 9:15	34	6.7	112.5
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	7/17/1996 10:30	37	7.1	121.6
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	7/6/2000 12:00	34.793	6.6705	114.3
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	7/27/2001 0:05	33.00312	5.32326	104.3
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	8/9/2001 18:00	39.613	6.7776	126.8
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	Mixed	14300	13020101	SURFACE WATER	REGULAR	9/26/2001 11:05	34.28004	6.42165	112.0

Hardness Results for the Rio Grande at Otowi (USGS data set <10 years old)

County	Suid	Staid	Place Name	Land Use Group	Huc	Sample Medium Desc	Sample Type	Result Datetime	Calcium wf	Magnesium wf	Hardness mg/L CaCO3
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	MIXED	13020101	SURFACE WATER	REGULAR	7/6/2000 12:00	34.793	6.6705	114.3
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	MIXED	13020101	SURFACE WATER	REGULAR	7/27/2001 0:05	33.00312	5.32326	104.3
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	MIXED	13020101	SURFACE WATER	REGULAR	8/9/2001 18:00	39.613	6.7776	126.8
SANTA FE	RIOG	08313000	RIO GRANDE AT OTOWI BRIDGE NM	MIXED	13020101	SURFACE WATER	REGULAR	9/26/2001 11:05	34.28004	6.42165	112.0

Hardness Results for the Rio Grande from Embudo Crossing to Bernalillo (LANL data set)

Location Name	Sample Id	Collection Date	Sample Matrix	Filtered/ Nonfiltered	Analytical Suite Code	Analyte	Std Result	Std Units
Buckman Diversion SW	GF07090PGRDB01	24-Sep-07	WS	F	GENINORG	Hardness	108	mg/L
Buckman Diversion SW	GF07090PGRDB20	24-Sep-07	WS	F	GENINORG	Hardness	174	mg/L
Buckman Diversion SW	CAWR-08-12217	30-Jul-08	WS	F	GENINORG	Hardness	101	mg/L
Buckman Diversion SW	CAWR-08-12215	30-Jul-08	WS	F	GENINORG	Hardness	97.8	mg/L
Buckman Diversion SW	CAWR-08-15632	29-Sep-08	WS	F	GENINORG	Hardness	104	mg/L
Buckman Diversion SW	CAWR-09-1416	01-Dec-08	WS	F	GENINORG	Hardness	121	mg/L
Buckman Diversion SW	CAWR-09-2367	18-Feb-09	WS	F	GENINORG	Hardness	110	mg/L
Rio Grande at Bernalillo	7402WSSBGR	01-Feb-74	WS	F	GENINORG	Hardness	152	mg/L
Rio Grande at Bernalillo	WS7407012541	01-Jul-74	WS	F	GENINORG	Hardness	148	mg/L
Rio Grande at Bernalillo	7503WSSBGR	12-Mar-75	WS	F	GENINORG	Hardness	140	mg/L
Rio Grande at Bernalillo	7510WSSBGR	09-Oct-75	WS	F	GENINORG	Hardness	138	mg/L
Rio Grande at Bernalillo	7604WSSBGR	02-Apr-76	WS	F	GENINORG	Hardness	153	mg/L
Rio Grande at Bernalillo	7610WSSBGR	05-Oct-76	WS	F	GENINORG	Hardness	158	mg/L
Rio Grande at Bernalillo	7703WSSBGR	08-Mar-77	WS	F	GENINORG	Hardness	164	mg/L
Rio Grande at Bernalillo	7710WSSBGR	19-Oct-77	WS	F	GENINORG	Hardness	183	mg/L
Rio Grande at Bernalillo	7903WSSBGR	08-Mar-79	WS	F	GENINORG	Hardness	140	mg/L
Rio Grande at Bernalillo	8002WSSBGR	27-Feb-80	WS	F	GENINORG	Hardness	122	mg/L
Rio Grande at Bernalillo	8101WSSBGR	01-Jan-81	WS	F	GENINORG	Hardness	154	mg/L
Rio Grande at Bernalillo	8402WSSBGR	23-Feb-84	WS	F	GENINORG	Hardness	131	mg/L
Rio Grande at Bernalillo	8503WSSBGR	12-Mar-85	WS	F	GENINORG	Hardness	117	mg/L
Rio Grande at Bernalillo	8602WSSBGR	05-Feb-86	WS	F	GENINORG	Hardness	108	mg/L
Rio Grande at Bernalillo	8702WSSBGR	24-Feb-87	WS	F	GENINORG	Hardness	203	mg/L
Rio Grande at Bernalillo	8803WSSBGR	28-Mar-88	WS	F	GENINORG	Hardness	133	mg/L
Rio Grande at Bernalillo	8903WSSBGR	27-Mar-89	WS	F	GENINORG	Hardness	116	mg/L
Rio Grande at Bernalillo	9004WSSBGR	02-Apr-90	WS	F	GENINORG	Hardness	167	mg/L
Rio Grande at Bernalillo	9104WSSBGR	18-Apr-91	WS	F	GENINORG	Hardness	143	mg/L
Rio Grande at Bernalillo	9205WSSBGR	27-May-92	WS	F	GENINORG	Hardness	117	mg/L
Rio Grande at Bernalillo	9305WSSBGR	26-May-93	WS	F	GENINORG	Hardness	88	mg/L
Rio Grande at Bernalillo	9408WSSBGR	10-Aug-94	WS	F	GENINORG	Hardness	150	mg/L
Rio Grande at Embudo	6106WSSODU	30-Jun-61	WS	F	GENINORG	Hardness	128	mg/L
Rio Grande at Embudo	6108WSSODU	02-Aug-61	WS	F	GENINORG	Hardness	132	mg/L
Rio Grande at Embudo	6109WSSODU	08-Sep-61	WS	F	GENINORG	Hardness	90	mg/L
Rio Grande at Embudo	6110WSSODU	03-Oct-61	WS	F	GENINORG	Hardness	161	mg/L

Hardness Results for the Rio Grande from Embudo Crossing to Bernalillo (LANL data set)

Location Name	Sample Id	Collection Date	Sample Matrix	Filtered/ Nonfiltered	Analytical Suite Code	Analyte	Std Result	Std Units
Rio Grande at Embudo	WS6111024671	02-Nov-61	WS	F	GENINORG	Hardness	122	mg/L
Rio Grande at Embudo	WS6111294671	29-Nov-61	WS	F	GENINORG	Hardness	106	mg/L
Rio Grande at Embudo	WS6201034671	03-Jan-62	WS	F	GENINORG	Hardness	104	mg/L
Rio Grande at Embudo	WS6201314671	31-Jan-62	WS	F	GENINORG	Hardness	94	mg/L
Rio Grande at Embudo	6203WSSODU	31-Mar-62	WS	F	GENINORG	Hardness	106	mg/L
Rio Grande at Embudo	WS6204024671	02-Apr-62	WS	F	GENINORG	Hardness	103	mg/L
Rio Grande at Embudo	WS62041174671	17-Apr-62	WS	F	GENINORG	Hardness	109	mg/L
Rio Grande at Embudo	6205WSSODU	03-May-62	WS	F	GENINORG	Hardness	85	mg/L
Rio Grande at Embudo	6206WSSODU	05-Jun-62	WS	F	GENINORG	Hardness	140	mg/L
Rio Grande at Embudo	6208WSSODU	01-Aug-62	WS	F	GENINORG	Hardness	109	mg/L
Rio Grande at Embudo	6211WSSODU	01-Nov-62	WS	F	GENINORG	Hardness	82	mg/L
Rio Grande at Embudo	6212WSSODU	01-Dec-62	WS	F	GENINORG	Hardness	121	mg/L
Rio Grande at Embudo	6302WSSODU	01-Feb-63	WS	F	GENINORG	Hardness	105	mg/L
Rio Grande at Embudo	WS6303014671	01-Mar-63	WS	F	GENINORG	Hardness	107	mg/L
Rio Grande at Embudo	WS6303054671	05-Mar-63	WS	F	GENINORG	Hardness	104	mg/L
Rio Grande at Embudo	WS6303094671	09-Mar-63	WS	F	GENINORG	Hardness	115	mg/L
Rio Grande at Embudo	6307WSSODU	03-Jul-63	WS	F	GENINORG	Hardness	145	mg/L
Rio Grande at Embudo	6407WSSODU	01-Jul-64	WS	F	GENINORG	Hardness	100	mg/L
Rio Grande at Embudo	6410WSSODU	01-Oct-64	WS	F	GENINORG	Hardness	104	mg/L
Rio Grande at Embudo	6501WSSODU	01-Jan-65	WS	F	GENINORG	Hardness	96	mg/L
Rio Grande at Embudo	6504WSSODU	01-Apr-65	WS	F	GENINORG	Hardness	114	mg/L
Rio Grande at Embudo	6507WSSODU	01-Jul-65	WS	F	GENINORG	Hardness	126	mg/L
Rio Grande at Embudo	WS6609018281	01-Sep-66	WS	F	GENINORG	Hardness	168	mg/L
Rio Grande at Embudo	WS6612018281	01-Dec-66	WS	F	GENINORG	Hardness	116	mg/L
Rio Grande at Embudo	WS6703018281	01-Mar-67	WS	F	GENINORG	Hardness	106	mg/L
Rio Grande at Embudo	WS6706018281	01-Jun-67	WS	F	GENINORG	Hardness	150	mg/L
Rio Grande at Embudo	WS6912018281	01-Dec-69	WS	F	GENINORG	Hardness	110	mg/L
Rio Grande at Embudo	7402WSSODU	01-Feb-74	WS	F	GENINORG	Hardness	104	mg/L
Rio Grande at Embudo	WS7407014671	01-Jul-74	WS	F	GENINORG	Hardness	124	mg/L
Rio Grande at Embudo	7503WSSODU	11-Mar-75	WS	F	GENINORG	Hardness	104	mg/L
Rio Grande at Embudo	WS7510074671	07-Oct-75	WS	F	GENINORG	Hardness	106	mg/L
Rio Grande at Embudo	7604WSSODU	28-Apr-76	WS	F	GENINORG	Hardness	113	mg/L
Rio Grande at Embudo	7711WSSODU	18-Nov-77	WS	F	GENINORG	Hardness	105	mg/L

Hardness Results for the Rio Grande from Embudo Crossing to Bernalillo (LANL data set)

Location Name	Sample Id	Collection Date	Sample Matrix	Filtered/ Nonfiltered	Analytical Suite Code	Analyte	Std Result	Std Units
Rio Grande at Embudo	7903WSSODU	07-Mar-79	WS	F	GENINORG	Hardness	106	mg/L
Rio Grande at Embudo	8002WSSODU	26-Feb-80	WS	F	GENINORG	Hardness	88	mg/L
Rio Grande at Embudo	8101WSSODU	01-Jan-81	WS	F	GENINORG	Hardness	108	mg/L
Rio Grande at Embudo	8402WSSODU	22-Feb-84	WS	F	GENINORG	Hardness	101	mg/L
Rio Grande at Embudo	8503WSSODU	11-Mar-85	WS	F	GENINORG	Hardness	95	mg/L
Rio Grande at Embudo	8602WSSODU	05-Feb-86	WS	F	GENINORG	Hardness	85	mg/L
Rio Grande at Embudo	8702WSSODU	24-Feb-87	WS	F	GENINORG	Hardness	177	mg/L
Rio Grande at Embudo	8803WSSODU	28-Mar-88	WS	F	GENINORG	Hardness	95	mg/L
Rio Grande at Embudo	8903WSSODU	27-Mar-89	WS	F	GENINORG	Hardness	82	mg/L
Rio Grande at Embudo	9004WSSODU	02-Apr-90	WS	F	GENINORG	Hardness	139	mg/L
Rio Grande at Embudo	9104WSSODU	17-Apr-91	WS	F	GENINORG	Hardness	101	mg/L
Rio Grande at Embudo	9205WSSODU	26-May-92	WS	F	GENINORG	Hardness	99	mg/L
Rio Grande at Embudo	9305WSSODU	25-May-93	WS	F	GENINORG	Hardness	82	mg/L
Rio Grande at Embudo	9407WSSODU	25-Jul-94	WS	F	GENINORG	Hardness	138	mg/L
Rio Grande at Embudo	MM97101WEGR	07-Oct-97	WS	F	GENINORG	Hardness	90.5	mg/L
Rio Grande at Embudo	MM98101WEGR	28-Oct-98	WS	F	GENINORG	Hardness	117.5	mg/L
Rio Grande at Embudo	CM99101WEGR	05-Oct-99	WS	F	GENINORG	Hardness	85.1	mg/L
Rio Grande at Embudo (bank)	CC00071WEGR	12-Jul-00	WS	F	GENINORG	Hardness	99.3	mg/L
Rio Grande at Embudo (bank)	GF01081WEGR	01-Aug-01	WS	F	GENINORG	Hardness	99.1	mg/L
Rio Grande at Embudo (bank)	GF02050WEGR01	22-May-02	WS	F	GENINORG	Hardness	109	mg/L
Rio Grande at Embudo (bank)	GF03080WEGR01	05-Aug-03	WS	F	GENINORG	Hardness	107	mg/L
Rio Grande at Embudo (bank)	GF04060WEGR01	30-Jun-04	WS	F	GENINORG	Hardness	87.1	mg/L
Rio Grande at Embudo (bank)	GF05060PEGR01	24-Jun-05	WS	F	GENINORG	Hardness	47.2	mg/L
Rio Grande at Frijoles	GF05090PRGF01	28-Sep-05	WS	F	GENINORG	Hardness	101	mg/L
Rio Grande at Frijoles	GF070900PRGF01	26-Sep-07	WS	F	GENINORG	Hardness	120	mg/L
Rio Grande at Frijoles	CAWR-08-15450	01-Oct-08	WS	F	GENINORG	Hardness	104	mg/L
Rio Grande at Frijoles	CAWR-08-15448	01-Oct-08	WS	F	GENINORG	Hardness	103	mg/L
Rio Grande at Frijoles (bank)	9310WSSBFR	14-Oct-93	WS	F	GENINORG	Hardness	50	mg/L
Rio Grande at Frijoles (bank)	9409WSSBFR	30-Sep-94	WS	F	GENINORG	Hardness	104	mg/L
Rio Grande at Frijoles (bank)	MM97091WBFR	30-Sep-97	WS	F	GENINORG	Hardness	59.5	mg/L
Rio Grande at Frijoles (bank)	CM99091WBFR	22-Sep-99	WS	F	GENINORG	Hardness	91.6	mg/L
Rio Grande at Frijoles (bank)	CM99092WBFR	22-Sep-99	WS	F	GENINORG	Hardness	92.7	mg/L
Rio Grande at Frijoles (bank)	GC00091WBFR	27-Sep-00	WS	F	GENINORG	Hardness	147	mg/L

Hardness Results for the Rio Grande from Embudo Crossing to Bernalillo (LANL data set)

Location Name	Sample Id	Collection Date	Sample Matrix	Filtered/ Nonfiltered	Analytical Suite Code	Analyte	Std Result	Std Units
Rio Grande at Frijoles (bank)	GF01091WBF8R	26-Sep-01	WS	F	GENINORG	Hardness	120	mg/L
Rio Grande at Frijoles (bank)	GF02100WBF8R01	22-Oct-02	WS	F	GENINORG	Hardness	167	mg/L
Rio Grande at Frijoles (bank)	GF03080WBF8R01	08-Oct-03	WS	F	GENINORG	Hardness	137	mg/L
Rio Grande at Frijoles (bank)	GF04090WBF8R01	15-Sep-04	WS	F	GENINORG	Hardness	118	mg/L
Rio Grande at Otowi	WS6609018491	01-Sep-66	WS	F	GENINORG	Hardness	150	mg/L
Rio Grande at Otowi	WS6612018491	01-Dec-66	WS	F	GENINORG	Hardness	158	mg/L
Rio Grande at Otowi	WS6703018491	01-Mar-67	WS	F	GENINORG	Hardness	136	mg/L
Rio Grande at Otowi	WS6706018491	01-Jun-67	WS	F	GENINORG	Hardness	126	mg/L
Rio Grande at Otowi	WS6912018501	01-Dec-69	WS	F	GENINORG	Hardness	150	mg/L
Rio Grande at Otowi (bank)	6107W5SK80	01-Jul-61	WS	F	GENINORG	Hardness	116	mg/L
Rio Grande at Otowi (bank)	6108W5SK80	01-Aug-61	WS	F	GENINORG	Hardness	142	mg/L
Rio Grande at Otowi (bank)	6109W5SK80	01-Sep-61	WS	F	GENINORG	Hardness	154	mg/L
Rio Grande at Otowi (bank)	6110W5SK80	01-Oct-61	WS	F	GENINORG	Hardness	128	mg/L
Rio Grande at Otowi (bank)	6111W5SK80	01-Nov-61	WS	F	GENINORG	Hardness	108	mg/L
Rio Grande at Otowi (bank)	6112W5SK80	01-Dec-61	WS	F	GENINORG	Hardness	95	mg/L
Rio Grande at Otowi (bank)	6201W5SK80	01-Jan-62	WS	F	GENINORG	Hardness	120	mg/L
Rio Grande at Otowi (bank)	6202W5SK80	01-Feb-62	WS	F	GENINORG	Hardness	125	mg/L
Rio Grande at Otowi (bank)	6203W5SK80	01-Mar-62	WS	F	GENINORG	Hardness	133	mg/L
Rio Grande at Otowi (bank)	6204W5SK80	01-Apr-62	WS	F	GENINORG	Hardness	96	mg/L
Rio Grande at Otowi (bank)	6205W5SK80	01-May-62	WS	F	GENINORG	Hardness	81	mg/L
Rio Grande at Otowi (bank)	6206W5SK80	01-Jun-62	WS	F	GENINORG	Hardness	86	mg/L
Rio Grande at Otowi (bank)	6207W5SK80	01-Jul-62	WS	F	GENINORG	Hardness	114	mg/L
Rio Grande at Otowi (bank)	6209W5SK80	01-Sep-62	WS	F	GENINORG	Hardness	125	mg/L
Rio Grande at Otowi (bank)	6301W5SK80	01-Jan-63	WS	F	GENINORG	Hardness	144	mg/L
Rio Grande at Otowi (bank)	6303W5SK80	01-Mar-63	WS	F	GENINORG	Hardness	118	mg/L
Rio Grande at Otowi (bank)	6306W5SK80	18-Jun-63	WS	F	GENINORG	Hardness	121	mg/L
Rio Grande at Otowi (bank)	6407W5SK80	01-Jul-64	WS	F	GENINORG	Hardness	152	mg/L
Rio Grande at Otowi (bank)	6410W5SK80	01-Oct-64	WS	F	GENINORG	Hardness	133	mg/L
Rio Grande at Otowi (bank)	6501W5SK80	01-Jan-65	WS	F	GENINORG	Hardness	129	mg/L
Rio Grande at Otowi (bank)	6504W5SK80	01-Apr-65	WS	F	GENINORG	Hardness	102	mg/L
Rio Grande at Otowi (bank)	6507W5SK80	01-Jul-65	WS	F	GENINORG	Hardness	136	mg/L
Rio Grande at Otowi (bank)	6510W5SK80	01-Oct-65	WS	F	GENINORG	Hardness	130	mg/L
Rio Grande at Otowi (bank)	7402W5SK80	01-Feb-74	WS	F	GENINORG	Hardness	140	mg/L

Hardness Results for the Rio Grande from Embudo Crossing to Bernalillo (LANL data set)

Location Name	Sample Id	Collection Date	Sample Matrix	Filtered/ Nonfiltered	Analytical Suite Code	Analyte	Std Result	Std Units
Rio Grande at Otowi (bank)	WS7407013601	01-Jul-74	WS	F	GENINORG	Hardness	148	mg/L
Rio Grande at Otowi (bank)	7503WSSKBO	11-Mar-75	WS	F	GENINORG	Hardness	132	mg/L
Rio Grande at Otowi (bank)	WS7510073601	07-Oct-75	WS	F	GENINORG	Hardness	180	mg/L
Rio Grande at Otowi (bank)	7604WSSKBO	08-Apr-76	WS	F	GENINORG	Hardness	125	mg/L
Rio Grande at Otowi (bank)	7703WSSKBO	08-Mar-77	WS	F	GENINORG	Hardness	138	mg/L
Rio Grande at Otowi (bank)	7710WSSKBO	18-Oct-77	WS	F	GENINORG	Hardness	145	mg/L
Rio Grande at Otowi (bank)	7903WSSKBO	07-Mar-79	WS	F	GENINORG	Hardness	135	mg/L
Rio Grande at Otowi (bank)	8002WSSKBO	26-Feb-80	WS	F	GENINORG	Hardness	108	mg/L
Rio Grande at Otowi (bank)	8101WSSKBO	01-Jan-81	WS	F	GENINORG	Hardness	130	mg/L
Rio Grande at Otowi (bank)	8402WSSKBO	22-Feb-84	WS	F	GENINORG	Hardness	113	mg/L
Rio Grande at Otowi (bank)	8503WSSKBO	11-Mar-85	WS	F	GENINORG	Hardness	116	mg/L
Rio Grande at Otowi (bank)	8602WSSKBO	05-Feb-86	WS	F	GENINORG	Hardness	104	mg/L
Rio Grande at Otowi (bank)	8702WSSKBO	24-Feb-87	WS	F	GENINORG	Hardness	175	mg/L
Rio Grande at Otowi (bank)	8803WSSKBO	28-Mar-88	WS	F	GENINORG	Hardness	96	mg/L
Rio Grande at Otowi (bank)	8903WSSKBO	27-Mar-89	WS	F	GENINORG	Hardness	120	mg/L
Rio Grande at Otowi (bank)	9004WSSKBO	02-Apr-90	WS	F	GENINORG	Hardness	154	mg/L
Rio Grande at Otowi (bank)	9104WSSKBO	17-Apr-91	WS	F	GENINORG	Hardness	139	mg/L
Rio Grande at Otowi (bank)	9205WSSKBO	26-May-92	WS	F	GENINORG	Hardness	122	mg/L
Rio Grande at Otowi (bank)	9305WSSKBO	23-May-93	WS	F	GENINORG	Hardness	105	mg/L
Rio Grande at Otowi (bank)	9408WSSKBO	09-Aug-94	WS	F	GENINORG	Hardness	95	mg/L
Rio Grande at Otowi (bank)	MM97121WBOR	01-Dec-97	WS	F	GENINORG	Hardness	79.1	mg/L
Rio Grande at Otowi (bank)	MM98081WBOR	05-Aug-98	WS	F	GENINORG	Hardness	111	mg/L
Rio Grande at Otowi (bank)	CC00081WBOR	14-Aug-00	WS	F	GENINORG	Hardness	122.3	mg/L
Rio Grande at Otowi (bank)	GF01071WBOR	17-Jul-01	WS	F	GENINORG	Hardness	107	mg/L
Rio Grande at Otowi Bridge	GF03090TOGR01	06-Sep-03	WS	F	GENINORG	Hardness	124	mg/L
Rio Grande at Otowi Bridge	CAWR-08-12213	30-Jul-08	WS	F	GENINORG	Hardness	105	mg/L
Rio Grande at Otowi Bridge	CAWR-08-15565	29-Sep-08	WS	F	GENINORG	Hardness	101	mg/L
Rio Grande at Otowi Bridge	CAWR-09-1414	01-Dec-08	WS	F	GENINORG	Hardness	125	mg/L
Rio Grande at Otowi Bridge	CAWR-09-2363	18-Feb-09	WS	F	GENINORG	Hardness	109	mg/L
Rio Grande at Otowi Upper (bank)	MM97121WUOR	01-Dec-97	WS	F	GENINORG	Hardness	4	mg/L
Rio Grande at Otowi Upper (bank)	MM98081WUOR	05-Aug-98	WS	F	GENINORG	Hardness	99	mg/L
Rio Grande at Otowi Upper (bank)	CM99081WUOR	03-Aug-99	WS	F	GENINORG	Hardness	91.3	mg/L
Rio Grande at Otowi Upper (bank)	CC00081WUOR	14-Aug-00	WS	F	GENINORG	Hardness	120.8	mg/L

Hardness Results for the Rio Grande from Embudo Crossing to Bernalillo (LANL data set)

Location Name	Sample Id	Collection Date	Sample Matrix	Filtered/ Nonfiltered	Analytical Suite Code	Analyte	Std Result	Std Units
Rio Grande at Otowi Upper (bank)	GF01071WUOR	17-Jul-01	WS	F	GENINORG	Hardness	103	mg/L
Rio Grande at Otowi Upper (bank)	GF02060WUOR01	01-Jul-02	WS	F	GENINORG	Hardness	135	mg/L
Rio Grande at Otowi Upper (bank)	GF03080WUOR01	07-Aug-03	WS	F	GENINORG	Hardness	115	mg/L
Rio Grande at Otowi Upper (bank)	GF04060WUOR01	07-Jul-04	WS	F	GENINORG	Hardness	119	mg/L
Rio Grande at Otowi Upper (bank)	GF05060PUOR01	27-Jun-05	WS	F	GENINORG	Hardness	63.5	mg/L
Rio Grande below Cochiti	WS6108152561	15-Aug-61	WS	F	GENINORG	Hardness	109	mg/L
Rio Grande below Cochiti	WS6108302561	30-Aug-61	WS	F	GENINORG	Hardness	79	mg/L
Rio Grande below Cochiti	WS6109122561	12-Sep-61	WS	F	GENINORG	Hardness	124	mg/L
Rio Grande below Cochiti	WS6109262561	26-Sep-61	WS	F	GENINORG	Hardness	134	mg/L
Rio Grande below Cochiti	6110WSSCCR	10-Oct-61	WS	F	GENINORG	Hardness	92	mg/L
Rio Grande below Cochiti	WS6111062561	06-Nov-61	WS	F	GENINORG	Hardness	111	mg/L
Rio Grande below Cochiti	WS6111262561	26-Nov-61	WS	F	GENINORG	Hardness	110	mg/L
Rio Grande below Cochiti	WS6112172561	17-Dec-61	WS	F	GENINORG	Hardness	80	mg/L
Rio Grande below Cochiti	WS6112302561	30-Dec-61	WS	F	GENINORG	Hardness	114	mg/L
Rio Grande below Cochiti	6202WSSCCR	13-Feb-62	WS	F	GENINORG	Hardness	143	mg/L
Rio Grande below Cochiti	WS6203012561	01-Mar-62	WS	F	GENINORG	Hardness	132	mg/L
Rio Grande below Cochiti	WS6203172561	17-Mar-62	WS	F	GENINORG	Hardness	137	mg/L
Rio Grande below Cochiti	6204WSSCCR	04-Apr-62	WS	F	GENINORG	Hardness	132	mg/L
Rio Grande below Cochiti	6205WSSCCR	16-May-62	WS	F	GENINORG	Hardness	89	mg/L
Rio Grande below Cochiti	6207WSSCCR	18-Jul-62	WS	F	GENINORG	Hardness	70	mg/L
Rio Grande below Cochiti	WS6208022561	02-Aug-62	WS	F	GENINORG	Hardness	151	mg/L
Rio Grande below Cochiti	WS6208082561	08-Aug-62	WS	F	GENINORG	Hardness	153	mg/L
Rio Grande below Cochiti	WS6208142561	14-Aug-62	WS	F	GENINORG	Hardness	116	mg/L
Rio Grande below Cochiti	WS6208232561	23-Aug-62	WS	F	GENINORG	Hardness	108	mg/L
Rio Grande below Cochiti	6209WSSCCR	01-Sep-62	WS	F	GENINORG	Hardness	132	mg/L
Rio Grande below Cochiti	6210WSSCCR	01-Oct-62	WS	F	GENINORG	Hardness	69	mg/L
Rio Grande below Cochiti	6212WSSCCR	01-Dec-62	WS	F	GENINORG	Hardness	140	mg/L
Rio Grande below Cochiti	6303WSSCCR	01-Mar-63	WS	F	GENINORG	Hardness	138	mg/L
Rio Grande below Cochiti	WS6305012561	01-May-63	WS	F	GENINORG	Hardness	132	mg/L
Rio Grande below Cochiti	WS6305072561	07-May-63	WS	F	GENINORG	Hardness	130	mg/L
Rio Grande below Cochiti	6507WSSCCR	01-Jul-65	WS	F	GENINORG	Hardness	352	mg/L
Rio Grande below Cochiti	6510WSSCCR	01-Oct-65	WS	F	GENINORG	Hardness	113	mg/L
Rio Grande below Cochiti	WS6609018271	01-Sep-66	WS	F	GENINORG	Hardness	152	mg/L

Hardness Results for the Rio Grande from Embudo Crossing to Bernalillo (LANL data set)

Location Name	Sample Id	Collection Date	Sample Matrix	Filtered/ Nonfiltered	Analytical Suite Code	Analyte	Std Result	Std Units
Rio Grande below Cochiti	W56612018271	01-Dec-66	WS	F	GENINORG	Hardness	136	mg/L
Rio Grande below Cochiti	W56703018271	01-Mar-67	WS	F	GENINORG	Hardness	144	mg/L
Rio Grande below Cochiti	W56706018271	01-Jun-67	WS	F	GENINORG	Hardness	144	mg/L
Rio Grande below Cochiti	W56909018271	01-Sep-69	WS	F	GENINORG	Hardness	164	mg/L
Rio Grande below Cochiti	W56912018271	01-Dec-69	WS	F	GENINORG	Hardness	140	mg/L
Rio Grande below Cochiti	7402WSSCGR	01-Feb-74	WS	F	GENINORG	Hardness	144	mg/L
Rio Grande below Cochiti	W57407012561	01-Jul-74	WS	F	GENINORG	Hardness	144	mg/L
Rio Grande below Cochiti	7503WSSCGR	12-Mar-75	WS	F	GENINORG	Hardness	128	mg/L
Rio Grande below Cochiti	7510WSSCGR	09-Oct-75	WS	F	GENINORG	Hardness	128	mg/L
Rio Grande below Cochiti	7604WSSCGR	02-Apr-76	WS	F	GENINORG	Hardness	133	mg/L
Rio Grande below Cochiti	7610WSSCGR	05-Oct-76	WS	F	GENINORG	Hardness	150	mg/L
Rio Grande below Cochiti	7703WSSCGR	08-Mar-77	WS	F	GENINORG	Hardness	142	mg/L
Rio Grande below Cochiti	7711WSSCGR	19-Nov-77	WS	F	GENINORG	Hardness	168	mg/L
Rio Grande below Cochiti	7903WSSCGR	08-Mar-79	WS	F	GENINORG	Hardness	130	mg/L
Rio Grande below Cochiti	8002WSSCGR	27-Feb-80	WS	F	GENINORG	Hardness	116	mg/L
Rio Grande below Cochiti	8101WSSCGR	01-Jan-81	WS	F	GENINORG	Hardness	126	mg/L
Rio Grande below Cochiti	8402WSSCGR	23-Feb-84	WS	F	GENINORG	Hardness	122	mg/L
Rio Grande below Cochiti	8503WSSCGR	12-Mar-85	WS	F	GENINORG	Hardness	118	mg/L
Rio Grande below Cochiti	8602WSSCGR	05-Feb-86	WS	F	GENINORG	Hardness	111	mg/L
Rio Grande below Cochiti	8702WSSCGR	24-Feb-87	WS	F	GENINORG	Hardness	195	mg/L
Rio Grande below Cochiti	8803WSSCGR	28-Mar-88	WS	F	GENINORG	Hardness	127	mg/L
Rio Grande below Cochiti	8903WSSCGR	27-Mar-89	WS	F	GENINORG	Hardness	107	mg/L
Rio Grande below Cochiti	9004WSSCGR	02-Apr-90	WS	F	GENINORG	Hardness	149	mg/L
Rio Grande below Cochiti	9104WSSCGR	18-Apr-91	WS	F	GENINORG	Hardness	142	mg/L
Rio Grande below Cochiti	9205WSSCGR	27-May-92	WS	F	GENINORG	Hardness	120	mg/L
Rio Grande below Cochiti	9305WSSCGR	26-May-93	WS	F	GENINORG	Hardness	85	mg/L
Rio Grande below Cochiti	9408WSSCGR	10-Aug-94	WS	F	GENINORG	Hardness	128	mg/L
Rio Grande below Cochiti	MM97102WCRG	07-Oct-97	WS	F	GENINORG	Hardness	69	mg/L
Rio Grande below Cochiti	MM97091WCCR	07-Oct-97	WS	F	GENINORG	Hardness	108	mg/L
Rio Grande below Cochiti	MM98111WCCR	11-Nov-98	WS	F	GENINORG	Hardness	158	mg/L
Rio Grande below Cochiti	GC00091WCCR	27-Sep-00	WS	F	GENINORG	Hardness	151	mg/L
Rio Grande below Cochiti	SF010905WCBR	26-Sep-01	WS	F	GENINORG	Hardness	126	mg/L
Rio Grande below Cochiti	GF01091WCCR	26-Sep-01	WS	F	GENINORG	Hardness	123	mg/L

Hardness Results for the Rio Grande from Embudo Crossing to Bernalillo (LANL data set)

Location Name	Sample Id	Collection Date	Sample Matrix	Filtered/ Nonfiltered	Analytical Suite Code	Analyte	Std Result	Std Units
Rio Grande below Cochiti	GF02120WCGR01	05-Dec-02	WS	F	GENINORG	Hardness	148	mg/L
Rio Grande below Cochiti	GF03090WCGR01	03-Sep-03	WS	F	GENINORG	Hardness	123	mg/L
Rio Grande below Cochiti	GF05060PCGR01	24-Jun-05	WS	F	GENINORG	Hardness	73.2	mg/L
Rio Grande near White Rock	SF000713WWGR	07-Jul-00	WS	F	GENINORG	Hardness	168	mg/L
Rio Grande near White Rock	GF03090TWR01	06-Sep-03	WS	F	GENINORG	Hardness	135	mg/L