



United States Department of the Interior

NATIONAL PARK SERVICE

Water Resources Division
1201 Oak Ridge Drive, Suite 250
Fort Collins, Colorado 80525-5596

IN REPLY REFER TO:

L54(2380)
General

OCT - 3 1996

Memorandum

To: Superintendent, Bandelier National Monument

From: Chief, Water Resources Division

Subject: Report of Water Quality Reconnaissance Conducted on September 7, 1996
by Lynette Stevens

The attached is a report by Lynette Stevens which presents the results of her water quality investigations conducted at the park on September 7, 1996. This sampling effort was conducted to provide the park with limited water quality information on the quality of Alamo Canyon and Alamo Springs downstream of the proposed Elk Meadows development.

If you have any questions on Lynette's report, please contact Gary Rosenlieb at (970) 225-3518.

Dan Kimball

cc: BAND - Sydoriak, Jacobs
2380 - Long, Minter



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Water Resources Division
1201 Oak Ridge Drive, Suite 250
Fort Collins, Colorado 80525-5596

IN REPLY REFER TO:

To: Gary Rosenlieb (WRD-NPS)
From: Lynette Stevens
Date: September 22, 1996
Re: Alamo Springs and Alamo Creek Sampling, BAND, September 6-9, 1996

Introduction:

Baseline data were collected in Alamo Canyon, Bandelier National Monument, NM, downstream of the proposed Elk Meadows development. Data were collected to provide Bandelier National Monument with some limited information on the quantity and quality of water in Alamo Canyon, both outside and inside the park boundary.

Sample Locations and Descriptions:

Alamo Creek (ALC) was sampled on September 7, 1996, downslope of the most upstream point on the Upper Crossing Alamo Creek trail, approximately 30 meters from the bend in the trail (see attached maps). This location is inside the park boundary. At the time of sampling, there was shallow yet measurable surface flow in Alamo Creek.

The Alamo Springs (ALS) grazing enclosure was sampled on September 8, 1996 (see attached maps). This enclosed area consisted of a series of shallow standing pools, seeps, and areas of shallow surface flow. In situ water quality measurements and water samples were collected in a 6' x 2' area of flowing water approximately 20 meters upstream of the outlet of the enclosure, near the north boundary fence. The depth of water in this sampling area was 0.2 feet at the deepest point.

Methods:

Basic water quality parameters measured in the field included pH, temperature, conductivity, and dissolved oxygen (APHA 1989). The hydrogen ion activity (pH) was measured with a Hach Model 44350 field probe, using Method 4500-H+ (APHA 1989). The field probe was calibrated prior to use with known laboratory standards of 4.0, 7.0, and 10.0 pH. Water temperature was measured with a standard mercury-filled Celsius field thermometer, according to Method 2550 (APHA 1989). The thermometer was placed in an area of flowing water in the stream for at least ten minutes before the temperature was recorded. Conductivity was measured with a Corning PS17 field probe, using Method 2510 (APHA 1989). The field probe was calibrated prior to use with a known laboratory standard of 1413 microsiemens per centimeter (s/cm). Dissolved oxygen (DO) was

measured in the field, using an EPA approved Azide modification of the Winkler buret titration method, according to Method 4500 O(C) (APHA 1989). Discharge in Alamo Creek was measured with a Gurley No. 625 pygmy current meter (see attached slides).

Standard operating procedures were employed when collecting and handling all water chemistry samples. All sample bottles were triple rinsed with stream water before taking depth-integrated grab samples. Replicate one liter water samples for later laboratory nitrate, nitrite, and ammonia analyses were collected and preserved by adding concentrated H_2SO_4 to a pH < 2.0 and cooling to 4° Celsius (APHA 1989). Replicate 500 mL water samples were filtered (0.45 micron) in the field and cooled to 4° Celsius (APHA 1989) for later laboratory orthophosphate analyses.

Replicate water samples were collected for fecal coliform analyses at both ALC and ALS using sterile, disposable 200 mL bags. Within the allowable six hours (Method 9060, APHA 1989), the stream water samples were analyzed using the FC membrane filter procedure (Method 9222 D, APHA 1989) outlined for field incubation units (Millipore 1992). Petri dishes were prepared with 2 mL growth media. Stream water sample volumes between 10 and 60 mL were filtered through a 0.7 micron filter (Millipore 1992). The filter was then placed in the petri dish, and incubated at 44.5° Celsius for 24 hours. Fecal coliform colonies were then counted and colonies were converted to colonies forming units per 100 mL (cfu/100 mL) of stream water.

All nutrient chemistry was performed at the NPS-WRD water chemistry laboratory, Ft. Collins, CO, using a Hach DR/3000 Spectrophotometer. The following Hach DR/3000 procedure codes were used (Hach 1990):

Nitrate - Code N.6; Cadmium Reduction

Nitrite - Code N.9; Diazotization Method

Ammonia - Code N.3; Nessler Method

Orthophosphate - Code P.4; Ascorbic Acid Method

Results:

Field water quality parameters and discharge measurements are summarized in Table 1. Nutrient chemistry and fecal coliform analyses are summarized in Table 2. Both tables contain the State of New Mexico's Water Quality Standard if published for the for the measured constituent. Appendix A contains a summary of data previously collected at Upper Alamo Crossing as part of Bandelier's monitoring program. To facilitate a comparison of the nutrient laboratory data to the State of New Mexico Water Quality the following data transformations were conducted.

1. Ammonia

New Mexico Standard: In any single sample, un-ionized ammonia (as N) shall not exceed 0.02 mg/l.

Transformation: The New Mexico standard is derived from the Environmental Protection Agencies Gold Book, which provides for a site specific calculation of the criteria based on aquatic species present, pH, and water temperature. The goal of this method is to provide

a total ammonia limit which will result in less than 0.02 mg/L un-ionized ammonia. For the purposes of Tables 2 in this report, the New Mexico standard is expressed as an equivalent concentration of total ammonia that would meet the unionized ammonia standard as determined for site-specific pH and temperature conditions.

2. Phosphorus

New Mexico Standard: In any single sample, total phosphorus as P shall be less than 0.1 mg/L.

Table 1: Water quality parameters measured in the field:

Parameter	ALC	ALS	New Mexico Standard
Water Temperature (° Celsius)	14	11	<20.0
Dissolved Oxygen (mg/L)	7.0	6.1	>6.0
pH	8.3	7.4	6.6 - 8.8
Conductivity (s/cm)	170	70	<300
Surface flow (cfs)	0.43	*not measured	Not Applicable

NOTES: * Flow measurement with a pygmy meter was not possible at ALS.

Table 2: Nutrient chemistry (n=2) and fecal coliform (n=3) results:

Parameter	ALC	ALS	New Mexico Standard
Nitrate (mg/L NO ₃ -N)	0.3	0.2	Not Applicable
Nitrite (mg/L NO ₂ -N)	0.002	0.003	Not Applicable
Ammonia (mg/L NH ₃ -N)	0.18	0.18	ALC - 1.81# ALS - 0.59#
Total Inorganic Nitrogen (mg/L N)	0.48	0.38	1.0
Orthophosphate (mg/L P)	0.13	0.034	<0.1
Fecal coliform (cfu/100 mL)	23	10	<200##

Represents the site-specific pH and temperature dependent total ammonia (NH₃-N) concentration equivalent to or less than 0.02 mg/L unionized ammonia for the protection

of cold water aquatic life and sensitive species (Quality Criteria for Water, Environmental Protection Agency, 1986.)

Single sample maximum

Transformation: Total phosphorus is the sum of orthophosphate, polyphosphates and organic phosphorus. Our lab capabilities only allowed us to measure orthophosphate, the bioavailable form of phosphorus. For this report, the measured orthophosphate as PO_4 were converted to $\text{PO}_4\text{-P}$ by multiplying the measured concentration of orthophosphate as PO_4 by the ratio of the atomic weight of phosphorus (31) to the molecular weight of orthophosphate (95) or 0.33

3. Nitrogen

New Mexico Standard:

In any single sample, total inorganic nitrogen, as N, shall be less than 1.0 mg/L.

Transformation:

Total inorganic nitrogen consists of nitrate nitrogen, nitrite nitrogen and ammonia nitrogen. The concentrations of these three constituents were summed to provide an estimate of total inorganic nitrogen consistent with the standard.

Discussion/Recommendations

All parameters measured, except for orthophosphate, were within acceptable limits when compared to the New Mexico Water Quality standards. The occurrence of orthophosphate in concentrations that exceed the standard is of note. Since orthophosphate is only one component of the of the phosphate group that, when analyzed for their combined concentrations, comprises a measurement of total phosphorus. The fact that orthophosphate alone exceeded the standard is of interest because this form of phosphorus is can be immediately assimilated by plant and animal life without any further biochemical breakdown. Its presence in high concentrations can lead to nuisance growth of certain algae. Additional sampling should be conducted for total phosphorus concentrations to determine if high concentrations seasonally persist, and that this single observation is not an artifact of sampling and or analytical error.

It was difficult to estimate flow and water quantity at Alamo Springs due to the nature of the spring enclosure. Bandelier personnel should consider installing at least two groundwater monitoring wells -- one at the enclosure inlet and one at the outlet -- to monitor groundwater levels on a monthly basis. Bandelier personnel might also consider installing a v-notch weir downstream of the enclosure where flow becomes constricted. At a very minimum, Bandelier personnel should map out the larger ponds and areas of surface flow in the enclosure, and take monthly water level readings to track water levels in the Alamo Spring enclosure over time.

Conductivity measured 9/7/96 was 170 s/cm, compared to a median of 105 s/cm measured during Bandelier's monitoring program. High conductivity in September 1996 is most likely due to higher-than-normal concentrations of dissolved solids as a result of the 1996 Dome Fire (see Appendix B).

In addition, Bandelier personnel should repeat all analyses in this report on a monthly or seasonal basis in order to obtain a more complete baseline data set for Alamo Creek and Alamo Springs before the development is constructed. Monitoring should continue during and after the construction in order to assess potential water quantity and quality impacts the development may have to Bandelier National Monument.

Literature Cited:

American Public Health Association (APHA). 1989. Standard Methods for the Examination of Water and Wastewater. 17th Edition. Washington, D.C.

Environmental Protection Agency (EPA). 1986. Quality Criteria for Water: 440/5/86/001. Washington D. C.

Hach Corporation. 1990. Hach DR/3000 Spectrophotometer Manual. Hach Corporation World Headquarters, Loveland, CO.

Millipore Corporation. 1992. Water Microbiology: Laboratory and Field Procedures. Bedford, Massachusetts. 57 pp.

New Mexico Water Quality Control Commission. 1991. Water Quality Standards for Interstate and Intrastate Streams in New Mexico.

Attachments

Station Inventory for Station: BAND0103

NPS Station ID: BAND0103
Location: Upper Alamo Crossing
Station Type: /TYPA/AMBNT/STREAM
RMI-Indexes:

LAT/LON: 35.791920/-106.352503

Agency: 11NPSWRD

Date Created: 03/09/96

FIPS State/County: 35043 NEW MEXICO/SANDOVAL

STORET Station ID(s): BAND_UA1

RMI-Miles:

HUC: 13020201

Depth of Water: 0

Aquifer:

Major Basin: WESTERN GULF

Elevation: 0

Water Body Id:

Minor Basin: RIO GRANDE UPPER ABOVE PECOS RIVER

ECO Region:

RF1 Index: 13020201

RF1 Mile Point: 0.000

Distance from RF1: 1.10

On/Off RF1:

RF3 Index: 13020101002812.68

RF3 Mile Point: 12.79

Distance from RF3: 0.02

On/Off RF3:

Description:

Station was part of Bandelier National Monument's monitoring program from 1977-1992. Station was located on the Frijoles 7.5 minute USGS quadrangle. Station and data are the responsibility of Brian Jacobs - Resource Management Specialist - at Bandelier National Monument (505-672-3861). Data were processed and uploaded to STORET by Dean Tucker at the NPS Water Resources Division in Fort Collins Colorado (970-225-3516).

Parameter Inventory for Station: BAND0103

Parameter	Period of Record	Obs	Median	Mean	Maximum	Minimum	Variance	Std. Dev.	10th	25th	75th	90th
00010 TEMPERATURE, WATER (DEGREES CENTIGRADE)	06/04/83-08/29/92	49	13.	12.122	16.	4.	8.151	2.855	8.	10.	14.	16.
00021 TEMPERATURE, AIR (DEGREES FAHRENHEIT)	06/04/83-08/29/92	49	68.	66.878	85.	46.	98.818	9.941	52.	59.	74.	80.
00052 HUMIDITY, RELATIVE (PERCENT)	06/04/83-10/05/91	44	58.	57.682	100.	24.	435.803	20.876	25.5	42.	73.	87.5
00094 SPECIFIC CONDUCTANCE, FIELD (UMHOS/CM @ 25C)	06/04/83-10/05/91	43	105.	102.884	140.	50.	366.439	19.143	75.6	93.	110.	132.
00300 OXYGEN, DISSOLVED	MG/L 06/15/85-10/05/91	15	8.2	8.133	9.3	7.1	0.488	0.699	7.16	7.4	8.7	9.24
00405 CARBON DIOXIDE (MG/L AS CO2)	05/03/88-10/05/91	12	29.	31.017	52.4	8.3	163.616	12.791	10.7	24.9	38.45	52.16
00406 PH, FIELD, STANDARD UNITS	SU 06/04/83-08/29/92	47	7.4	7.367	7.85	6.6	0.106	0.326	6.812	7.18	7.61	7.8
00406 CONVERTED PH, FIELD, STANDARD UNITS	06/04/83-08/29/92	47	7.4	7.235	7.85	6.6	0.124	0.352	6.812	7.18	7.61	7.8
00406 MICRO EQUIVALENTS/LITER OF H+ COMPUTED FROM PH	06/04/83-08/29/92	47	0.04	0.058	0.251	0.014	0.003	0.054	0.016	0.025	0.066	0.154
00410 ALKALINITY, TOTAL (MG/L AS CaCO3)	05/03/88-10/05/91	11	40.	38.273	68.	21.	171.618	13.1	21.4	25.	44.	63.4
70300 RESIDUE, TOTAL FILTRABLE (DRIED AT 180C), MG/L	05/03/88-07/26/88	5	41.	43.8	58.	39.	64.7	8.044	**	**	**	**
82078 TURBIDITY, FIELD NEPHELOMETRIC TURBIDITY UNITS, NTU	07/03/85-08/29/92	12	5.6	5.608	11.	2.6	6.015	2.453	2.66	3.45	7.	10.04

** - Less than 9 observations

- Computed with 50% or more of the total observations as values that were half the detection limit

p - Has a corresponding time series plot

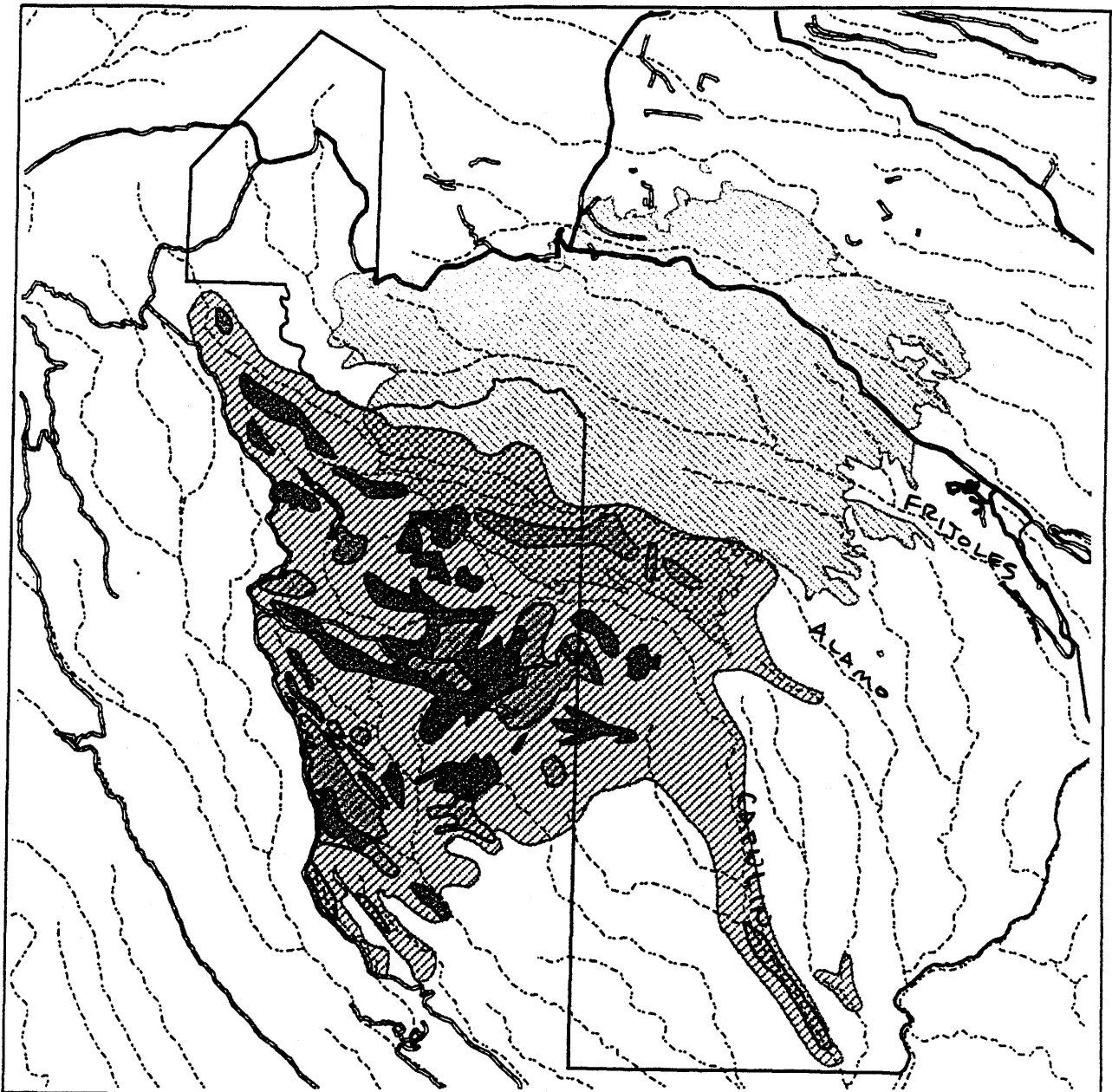
EPA Water Quality Criteria Analysis for Station: BAND0103

			Total	Exceed	Prop.	9/01- 2/14-----			2/15- 4/19-----			4/20- 6/30-----			7/01- 8/31-----		
Parameter		Std. Type	Obs	Standard	Exceeding	Obs	Exceed	Prop.	Obs	Exceed	Prop.	Obs	Exceed	Prop.	Obs	Exceed	Prop.
00300	OXYGEN, DISSOLVED	Other-Lo Lim.	15	0	0.00	1	0	0.00				11	0	0.00	3	0	0.00
00406	PH, FIELD	Other-Hi Lim.	47	0	0.00	11	0	0.00				21	0	0.00	15	0	0.00
		Other-Lo Lim.	47	0	0.00	11	0	0.00				21	0	0.00	15	0	0.00
82078	TURBIDITY, FIELD	Other-Hi Lim.	12	0	0.00	1	0	0.00				6	0	0.00	5	0	0.00

& - Below detection limit observations, for which half the detection limit exceeded the criterion, were excluded from the criterion comparison for this parameter

Appendix 2

Areas Burned by the 1977 La Mesa Fire & 1996 Dome Fire



- gravel roads
- paved roads
- Hydrology
- Dome Fire area 1996 (16,516 ac)
- La Mesa Fire area 1977 (14,269 ac)
- Bandelier boundary

Dome Fire burn intensity

- light to unburned mosaic
- low
- moderate
- high

Scale 1:120,000

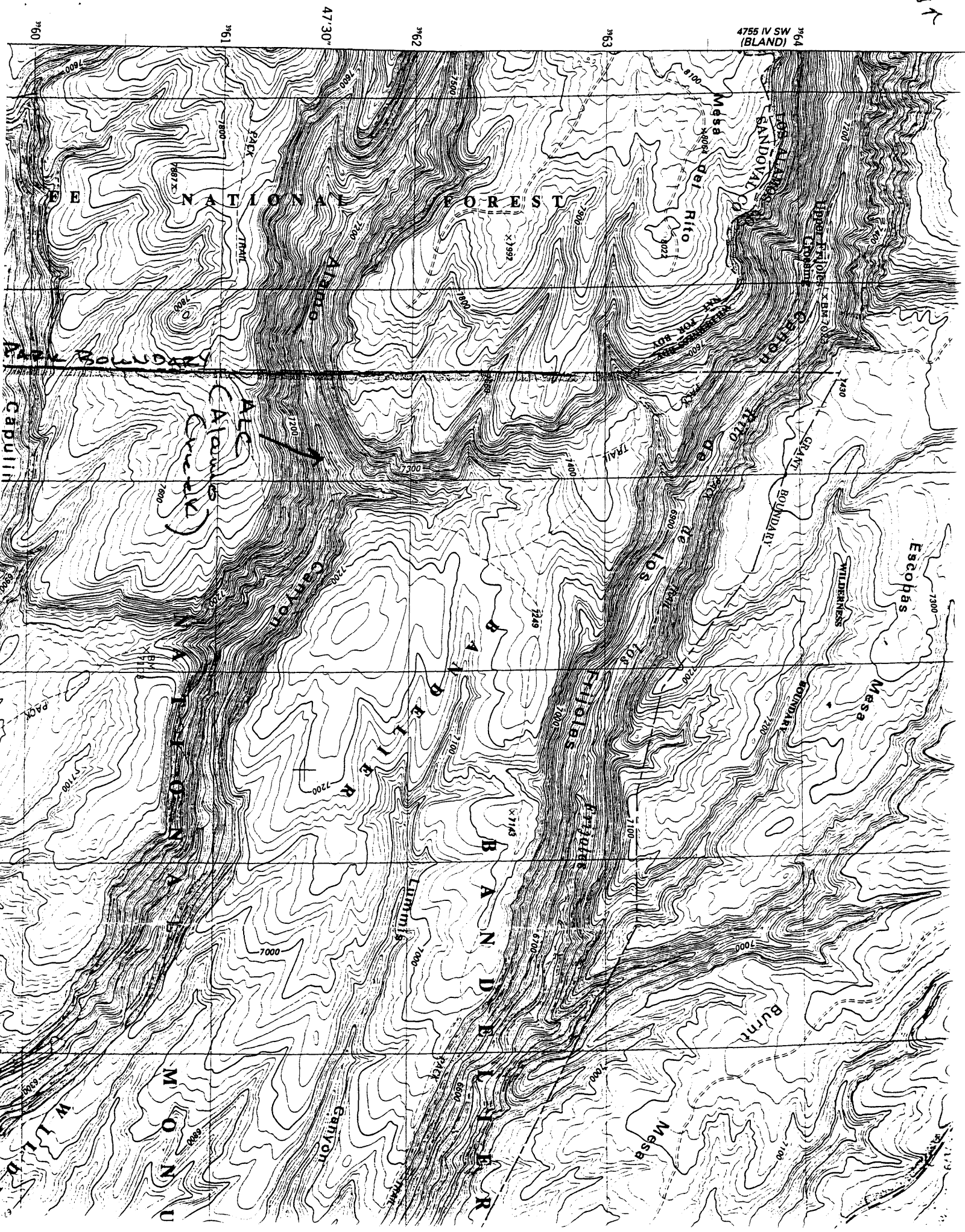
N

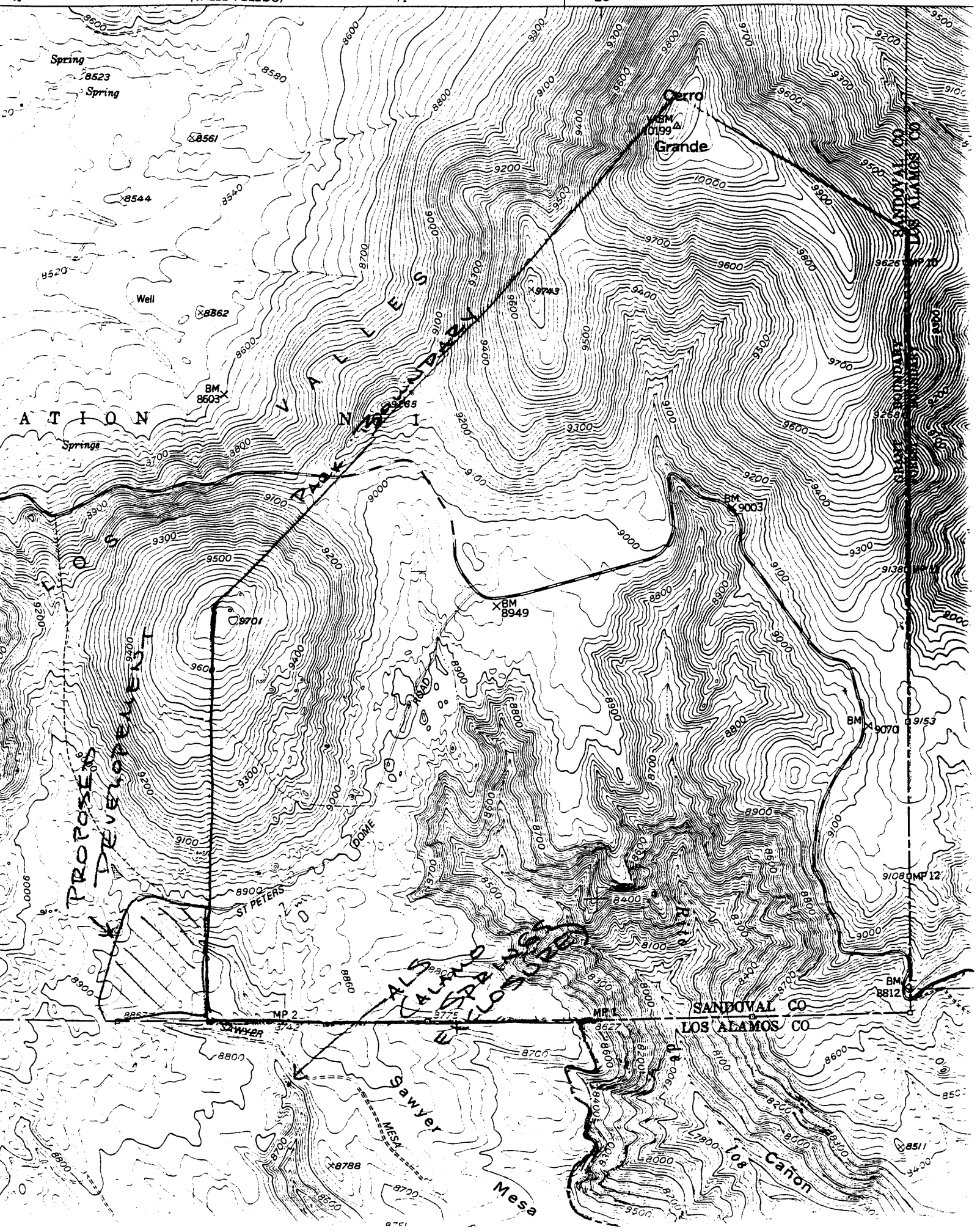
1 0 1 2 Miles

Data origin: La Mesa Fire data taken from 1977 aerial photos; Dome Fire perimeter from aerial GPS survey by SFNF; contour intervals created from USGS DEMs.

USGS Triangles, T. Mex. Quad

214





-all measurements in English units
(ft + sec and ft).

River at-											
ANGLE COEF- FICIENT	DIST. FROM INITIAL POINT	WIDTH	DEPTH	OBSERVA- TION DEPTH	REVO- LUTIONS	TIME IN SEC- ONDS	VELOCITY		ADJUST- ED FOR HOR. ANGLE OR	AREA	DISCHARGE
							AT POINT	MEAN IN VER- TICAL			
		ft	ft				cfs			-ft ²	cfs
	7.3	-	-		-	-	-				
	7.5	0.2	0.15		27	40	0.7			0.03	0.021
	7.7	0.2	0.2		48	40	1.2			0.04	0.048
	7.8	0.1	0.2		63	40	1.6			0.02	0.032
	7.9	0.1	0.2		67	40	1.7			0.02	0.034
	8.1	0.2	0.2		59	40	1.5			0.04	0.06
	8.2	0.1	0.2		63	40	1.6			0.02	0.032
	8.3	0.1	0.2		71	40	1.8			0.02	0.036
	8.5	0.2	0.2		84	40	2.1			0.04	0.084
	8.6	0.1	0.2		70	40	1.8			0.02	0.036
	8.7	0.1	0.2		43	40	1.1			0.02	0.022
0	8.9	0.2	0.15		30	40	0.8			0.03	0.024
	9.1	-	-		-	-	-				
							Σ	=		0.43	
										cfs	

TRB

LB

Bandelier nitrate analyses:

Date: 9/11/94

Time: 5³⁰ pm

Lab tech: L. Stevenson

Preservation: H_2SO_4 to $< pH 2$

- neutralize w/ 5.0N Sodium hydroxide b/d tests

Results:

Nitrate: Method: med range 0-5.0 mg/L Cadmium
Production
ALC-1 in mg/L NO_3-N } $\times 4.4 = NO_3$
0.3 mg/L }
ALC-2 }
0.2 mg/L }
ALS-1 }
0.1 mg/L }
ALS-2 }
0.3 mg/L }
Nitrite: Method: low range 0-0.350 mg/L Diazotization
method
ALC-1 in $mg/L NO_2-N$ } $\times 3.3 = NO_2$
0.002 mg/L }
ALC-2 }
0.001 mg/L }
ALS-1 }
0.003 mg/L }
ALS-2 }
0.003 mg/L }

Ammonia: Method: Range 0-3.00 mg/L Nessler Meth -
ALC-1 in mg/L NH_3-N }
0.17 }
ALC-2 }
0.18 }
ALS-1 }
0.16 }
ALS-2 }
0.19 }

Bandelier phosphate analyses:

Date: 9/10/96

Time: 1230

Method: Phosphate, Reactive (Orthophosphate)
HACH DR/3000 Procedure (code P.4)

Lab tech: L. Stevens

Ascorbic Acid Method

Corresponding field water quality:

(Adapted from

ALC → pH 8.3, cond 120 μ S/cm, DO 7.0 mg/L,

Standard

Preservation:

temp 14°C

Methods

- filtered in fld w/ 0.45 μ

15th ed, 1980

filter, temp below 4°C

Results: (in mg/L PO₄)

ALS → pH 7.2, cond 70 μ S/cm,
temp 11°C, DO 6.1 mg/L

ALC-1 0.412 mg/L

ALC-2 0.390 mg/L

ALS-1 0.112 mg/L

ALS-2 0.096 mg/L



can express as mg/L P by $\div$ by 3