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~~A-2617~~

May 7, 1992

MEMORANDUM

To: Superintendent, Saint-Gaudens NHS
From: Coordinator, Water Resources Program, NARO
Subject: Blow-Me-Down water quality monitoring

Enclosed please find a "draft" report on the water quality monitoring activities that have been conducted throughout the Blow-Me-Down watershed since 1982. I look forward to your comments and I will revise the report accordingly. Also, please note that I have requested technical reviews from the NAR Resource Management Branch, the NAR Chief Scientist, Michael Soukup, and John Portnoy (Cape Cod NS biologist).

Please call with any questions. Once again, I apologize for the delay.

Charles T. Roman
(401-792-6885)

cc: V. Rousseau
M. Foley
M. Soukup
J. Portnoy

**Review of Water Quality Sampling
in the Blow-Me-Down Brook Watershed
from 1982-1991**

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National Park Service
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DRAFT

Submitted to:

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May 1992

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INTRODUCTION

Blow-Me-Down Brook and the associated watershed drain into Blow-Me-Down Pond, and ultimately, the Connecticut River. Blow-Me-Down Pond and portions of the Brook are associated with Saint-Gaudens National Historic Site. On four occasions over the past decade (September 15, 1982; March 21, 1984; September 4, 1986; November 14, 1991)² the National Park Service (North Atlantic Region) performed baseline surface water quality monitoring to evaluate relative quality of the Blow-Me-Down watershed. The purpose of this report is to present and discuss these water quality data and provide some recommendations for future monitoring activities.

METHODS

Field Sampling

Nine stations were included in the sampling program (Table 1). During each sampling trip a surface water sample was collected from each station. On some trips, select measurements were taken in the field (i.e., water temperature and conductivity using a Yellow Springs Model #33 S-C-T Meter). Table 2 identifies the parameters measured during each trip. It is noted that data for the 4 September 1986 sampling, except for water temperature and conductivity, are missing. The files for this monitoring project indicate that water sample bottles were collected, yet analytical results could not be found.

² Michael Soukup, former Regional Chief Scientist and Water Resources Coordinator for the North Atlantic Region, directed the sampling efforts in the 1980s. Thanks are extended to Brendhan Zubricki, a University of Rhode Island graduate student, for assistance with data compilation.

Laboratory Procedures

The 11 November 1991 water samples were analyzed by the laboratory affiliated with the University of Rhode Island's Department of Civil and Environmental Engineering. The methods employed are shown in Table 3. Analytical Bio-Chemistry Laboratories, Inc. (Columbia, MO) performed analyses for the 15 September 1982 sample date according to the methods identified in Table 3. The project file does not include information on methods used for the 21 March 1984 samples, but it is assumed that procedures identified in "Standard Methods for the Examination of Water and Wastewater" were followed (APHA, AWWA, WPCF, 1980)

RESULTS AND DISCUSSION

Water quality results for all the sample dates are listed in Table 4. Given the sparse frequency of sampling (only 1-3 data points for each parameter over a 9 year period), lack of consistency among methods, different seasonal sample dates (i.e.; Sept., Nov., Mar.), and lack of water discharge data, it is difficult to evaluate or elucidate any long-term trends in the surface water quality of the Blow-Me-Down watershed. Recognizing these limitations to data interpretation, it is noted that few of the parameters measured appear to have changed appreciably over the 9 year monitoring period. For example, conductivity data are plotted for each station and each sample date in Fig. 1. Conductivity provides an indication of the total concentration of dissolved ions in the water. Distilled water may have a conductivity of up to 2 $\mu\text{mhos/cm}$, while conductivity of potable water in the U.S. ranges from 50-1,500 $\mu\text{mhos/cm}$ (APHA, AWWA, WPCF, 1980). As waters become "polluted," conductivity generally increases (upwards of 10,000 $\mu\text{mhos/cm}$). Except for Station 2, which may be influenced from Rt 12A road runoff, conductivities throughout the watershed are generally less than 200 $\mu\text{mhos/cm}$, with no consistent increasing or decreasing trends (Fig. 1). Of the nutrients (N and P) consistently monitored over the study period (total phosphorous, dissolved orthophosphate, nitrate, and ammonia) a slight decreasing

trend was noted, yet this interpretation must be viewed with caution due to the abovementioned limitation in the data set. Increasing concentration of nitrogen or phosphorous could indicate nonpoint source inputs from agricultural activities (fertilizer), septic system leachate, or enhanced soil erosion.

Blow-Me-Down water quality data were also compared to U.S. Environmental Protection Agency freshwater quality criteria (Table 5). Criteria are established for those water quality parameters essential to the protection of aquatic life. For all the criteria included in the comparison, except total iron, the Blow-Me-Down concentrations were below the acute and the more stringent, chronic levels. This suggests that the water quality throughout the Blow-Me-Down watershed is acceptable. Total iron concentration at Station 1 (Sept. 15, 1982) and Stations 4 and 9 (March 21, 1984) exceeded the EPA chronic criterion of 1 mg/L. Concentrations from all other stations in the 1982 and 1984 sampling were below the limit, while the 1991 concentrations appeared well below the criterion. Assuming that the elevated concentrations are real, the sources of the iron or biogeochemical processes responsible for mobilization of the iron are unknown. Regardless, based on the 1991 data, there does not appear to be any need for concern.

The caution required to interpret this entire data set can not be overstated, but given the known limitations it appears that the overall stream water quality of the Blow-Me-Down watershed is acceptable.

RECOMMENDATIONS

Stream water quality monitoring represents an essential component to detecting changes that may be responding to land use practices (e.g., agriculture, residential development, road runoff), acid

rain, altered hydrology (e.g., groundwater withdrawal, dams), or other factors occurring within a watershed. The baseline monitoring program at Saint-Gaudens NHS was designed to detect any significant water quality problems that may be impacting the Blow-Me-Down watershed and associated park aquatic resources. Water quality was found to be acceptable, yet given the trend toward increased residential/commercial development in the watershed, coupled with the acid rain impacts documented in the vicinity (i.e., Hubbard Brook), a continuation of water quality monitoring is warranted.

The sample frequency adopted since 1982 was probably adequate to detect major changes or impacts to stream water quality. To detect subtle changes, thereby enabling the implementation of preventative water quality enhancement management activities, a more refined sampling program is needed.

It is recommended that a regionwide small-parks water quality monitoring initiative be developed to address the need at Saint-Gaudens NHS, as well as, at Saratoga NHP, Minute Man NHP, Morristown NHP, and Roosevelt - Vanderbilt NHS. Each of these parks is faced with a similar need to monitor stream water quality given encroaching development. For the most part these parks lack the base funding and resource management staffs required to design and implement effective water quality monitoring programs. During the FY 93 call for projects from the Water Resources Division - WASO, it is proposed that the NAR Water Resources Coordinator request funds to hire a full-time manager to design and initiate monitoring programs at each of the mentioned parks. Monitoring objectives, sample frequency, parameters, field/lab techniques, data management, data analyses, and personnel needs, including an evaluation of volunteer efforts and establishment of partnerships with local communities/agencies, must all be considered. Once established, funds to maintain the monitoring can be solicited from the NAR Resource Management Program, WASO Inventory & Monitoring Program, park base, other NPS sources, and cooperative partnerships.

Table 1. Description of sample stations throughout the Blow-Me-Down watershed.

Station	Description
1	- Blow Me-Down Brook at discharge to Blow-Me-Down Pond (Fulling Mill Site)
2	- Clay Brook at Rt 12A (culvert)
3	- Blow-Me-Down Brook at Westgate Rd (culvert)
4	- Blow-Me-Down Brook just below confluence of Shipman Brook (off Stage Rd.)
5	- Shipman Brook at Stage Rd. (culvert)
6	- Blow-Me-Down Brook off Stage Rd. (bridge)
7	- Blow-Me-Down Brook, just upstream of confluence with Bryant Brook (bridge)
8	- Bryant Brook at Kenyon Rd. (culvert)
9	- Blow-Me-Down Brook at Cornish Stage Rd, near Underhill Rd. (bridge)

Table 2. Water quality parameters measured during each sample trip.

Parameter	Sample Date			
	Sept. 15 1982	Mar. 21 1984	Sept. 4 1986	Nov. 11 1991
Water Temp	✓	✓	✓	
Conductivity	✓	✓	✓	✓
Lab pH	✓	✓		✓
Total Suspended Solids (TSS)		✓		✓
Volatile Suspended Solids (VSS)				✓
Total Alkalinity	✓			✓
Total Phosphorous	✓	✓		✓
Dissolved Orthophosphate		✓		✓
Total Orthophosphate		✓		
Total Iron (Fe)	✓	✓		✓
Total Organic Carbon (TOC)	✓			
Sulfate (SO ₄)	✓	✓		✓
Nitrate + Nitrite (NO ₃ + NO ₂)				✓
Nitrate (NO ₃)	✓	✓		
Ammonia (NH ₃)	✓			✓
Kjeldahl Nitrogen	✓			
Chloride (Cl)	✓	✓		✓
Sodium (Na)		✓		✓
Calcium (Ca)		✓		✓
Potassium (K)		✓		
Magnesium (Mg)		✓		✓
Total Chromium (Tot Cr)				✓
Total Nickel (Tot Ni)				✓
Total Copper (Tot Cu)				✓
Total Lead (Tot Pb)				✓
Total Cadmium (Tot Cd)				✓

Table 3. Summary of laboratory methods for the 11 November 1991 and 15 September 1982 sample dates.

Parameter	Methodology	Reference
<i>November 11, 1991</i>		
pH	Electrometric Method Orion 407A pH Meter	STM ^a (4500-H ⁺)
Total Suspended and Volatile Solids	Gravimetric Method	STM (2540 D and 2540 E)
Total Alkalinity	Titration Method	STM (2320 B)
Nitrate, Orthophosphate and Total Phosphorus	Colorimetric Method Technicon Autoanalyzer II	MERL ^b
Ammonia	Phenate Method Milton-Roy Spectronic 1001	STM (4500-NH ₃ D)
Sodium, Calcium, Iron, and Magnesium	Flame Ionization Perkin-Elmer AA 3030 B	EPA ^c
Sulfate	Turbidimetric Method Milton-Roy Spectronic 1001	STM (4500-SO ₄ E)
Chloride	Potentiometric Method Orion Cl Electrode 94-178 Orion Reference 90-02	STM (4500-CL D)
Total Cadmium, Chromium, Copper, Lead and Nickel	Graphite Furnace Perkin-Elmer AA 5100 PC	EPA
<i>September 15, 1982</i>		
Total Iron	Inductively Coupled Argon Plasma Spectroscopy	
Potassium	Nitric: perchloric Digestion Perkin-Elmer 305B Spectrophotometer	
Total Organic Carbon	Oceanography Intl. Corp (Model 524C)	STM ^d (505)
Sulfate	Gravimetric Method	STM (426B)

Table 3. continued

Parameter	Methodology	Reference
Nitrate	Colorimetric Method Technicon AutoAnalyzer	STM (418F)
Ammonia	Colorimetric Method Technicon AutoAnalyzer	STM (417F)
Kjeldahl N	Colorimetric Method Technicon AutoAnalyzer	STM (420)
Chloride	Colorimetric Method Technicon AutoAnalyzer	STM (407)

^a APHA, AWWA, WPCF, Standard Methods for the Examination of Water and Wastewater, 17th Edition, 1989.

^b Marine Ecosystem Research Laboratory, Manual of Biological and Geochemical Techniques in Coastal Areas, Graduate School of Oceanography, University of Rhode Island, Kingston, RI, 1972.

^c U.S. Environmental Protection Agency, Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Environmental Monitoring and Support Laboratory, Cincinnati, OH, 1979.

^d APHA, AWWA, WPCF, Standard Methods for the Examination of Water and Wastewater, 15th Edition, 1980.

Table 4. Summary of water quality data for the Blow-Me-Down watershed (Saint Gaudens NHS).

Date	Station #	Water Temp (degrees C)	Conductivity (umhos/cm)	Lab pH	Tot Sus (mg/L)	Sol Vol (mg/L)	Sue Sol (mg/L)	Tot Alkal (mg/L CaCO3)	Total P (mg/L)	Dis Orho P (mg/L)	Tot Orho P (mg/L)	P Total (mg/L)	Fe (mg/L)	TOC (mg/L)	SO4 (mg/L)	NO2-NO3 (mg/L)
9/15/82	1	18.7	170	7.2	nd	nd	nd	61.4	0.02	nd	nd	nd	1.2	43.3	11	nd
9/15/82	2	18.5	335	7.26	nd	nd	nd	101.7	0.02	nd	nd	nd	0.67	48.6	8.2	nd
9/15/82	3	17.1	136	7.2	nd	nd	nd	52.1	0.02	nd	nd	nd	0.29	41.4	8	nd
9/15/82	6	16.2	172	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/15/82	7	17.3	165	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/15/82	8	15.2	75	7.02	nd	nd	nd	54.8	0.02	nd	nd	nd	0.31	44.6	8.5	nd
9/15/82	9	17.5	118	7.09	nd	nd	nd	39.6	0.03	nd	nd	nd	0.63	50.2	8.8	nd
9/15/82	10	15.9	68	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
3/21/84	1	0.5	90	6.76	14.5	nd	nd	nd	0.04	<0.1	<0.1	0.836	nd	nd	7.2	nd
3/21/84	2	0	121	6.65	9.84	nd	nd	nd	0.046	<0.1	<0.1	0.628	nd	11	nd	nd
3/21/84	3	0	132	6.6	<30	nd	nd	nd	0.033	<0.1	<0.1	0.525	nd	8.5	nd	nd
3/21/84	4	-0.2	149	nd	89	nd	nd	nd	0.26	nd	0.052	2.8	nd	5.6	nd	nd
3/21/84	5	-0.3	135	6.76	nd	nd	nd	nd	0.358	<0.1	nd	0.767	nd	8.5	nd	nd
3/21/84	6	-1.2	125	6.76	5.14	nd	nd	nd	0.023	nd	<0.1	0.456	nd	9	nd	nd
3/21/84	7	-1.5	141	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
3/21/84	8	-0.5	132	nd	nd	nd	nd	nd	0.018	nd	nd	0.421	nd	10	nd	nd
3/21/84	9	-0.7	57	nd	66.4	nd	nd	nd	0.088	nd	<0.1	1.66	nd	8.1	nd	nd
9/4/86	1	16.8	156	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	2	14.4	262.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	3	15	146.4	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	4	15	146.4	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	5	15.8	100	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	6	15.3	140.3	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	7	15.3	144	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	8	14	101	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	9	14.8	124	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
11/14/91	1	nd	125	7.62	13.5	1.8	nd	37	ndet	ndet	nd	nd	0.24	nd	32	0.34
11/14/91	2	nd	162	7.9	1.2	0.4	nd	45.6	ndet	ndet	nd	nd	0.217	nd	12.3	0.29
11/14/91	3	nd	112	7.75	3	1	nd	27.2	ndet	ndet	nd	nd	0.185	nd	9.1	0.39
11/14/91	5	nd	100	7.95	5.3	1.2	nd	45.6	ndet	ndet	nd	nd	0.176	nd	9.7	0.07
11/14/91	6	nd	102	7.62	2.8	0.6	nd	23.5	ndet	ndet	nd	nd	0.159	nd	12.5	0.34
11/14/91	7	nd	98	7.59	3.4	1	nd	22.1	ndet	ndet	nd	nd	0.168	nd	10.8	0.31
11/14/91	8	nd	100	7.62	2.5	0.6	nd	22.1	ndet	ndet	nd	nd	0.171	nd	10.4	0.32
11/14/91	9	nd	90	7.59	1.3	0.2	nd	20.6	ndet	ndet	nd	nd	0.127	nd	11.6	0.36

nd= no data

ndet= not detectable

Table 4. continued

Date	Station #	NO ₃ (mg/L)	NH ₃ (mg/L)	Kjeldahl N (mg/L)	Cl (mg/L)	Na (mg/L)	Ca (mg/L)	K (mg/L)	Mg (mg/L)	Tot Cr (ug/L)	Tot Ni (ug/L)	Tot Cu (ug/L)	Tot Pb (ug/L)	Tot Cd (ug/L)
9/15/82	1	0.49	0.13	0.4	19	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/15/82	2	3.54	0.07	0.48	57	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/15/82	3	1.28	0.09	0.32	12	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/15/82	6	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/15/82	7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/15/82	8	0.55	0.06	0.36	1	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/15/82	9	0.04	0.09	0.7	10	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/15/82	10	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
3/21/84	1	0.3	nd	nd	7.75	5.29	8.97	0.778	1.46	nd	nd	nd	nd	nd
3/21/84	2	0.24	nd	nd	11.9	7.13	8.85	0.308	1.37	nd	nd	nd	nd	nd
3/21/84	3	0.3	nd	nd	6.56	5.75	4.22	0.795	1.2	nd	nd	nd	nd	nd
3/21/84	4	1.32	nd	nd	2.42	1.62	7.93	0.447	3.5	nd	nd	nd	nd	nd
3/21/84	5	0.2	nd	nd	6.91	1.62	11.8	0.43	1.08	nd	nd	nd	nd	nd
3/21/84	6	0.31	nd	nd	5.85	3.46	7.28	0.504	1.03	nd	nd	nd	nd	nd
3/21/84	7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
3/21/84	8	0.13	nd	nd	1.15	2.08	5.71	0.33	1.12	nd	nd	nd	nd	nd
3/21/84	9	0.3	nd	nd	4.92	4.83	3.37	0.986	1.54	nd	nd	nd	nd	nd
9/4/86	1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	3	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	4	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	6	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9/4/86	9	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
11/14/91	1	nd	0.045	nd	15.5	8.1	10.7	nd	2.1	0.75	0.5	7.1	1.1	0.11
11/14/91	2	nd	ndet	nd	22.5	12.6	17.6	nd	3	1	0.4	7	0.6	0.09
11/14/91	3	nd	0.005	nd	13.9	6.9	9	nd	1.9	0.75	0.4	1.6	0.5	0.1
11/14/91	5	nd	ndet	nd	6	15	13.9	nd	1.6	0.8	0.5	8	0.9	0.18
11/14/91	6	nd	0.017	nd	11.9	6.6	6	nd	1.7	0.65	ndet	6.9	0.6	0.23
11/14/91	7	nd	ndet	nd	11.5	6	5.5	nd	1.7	1.2	0.5	8.3	0.8	0.7
11/14/91	8	nd	ndet	nd	11.9	6.9	6.1	nd	1.9	1.3	0.6	1.5	0.4	0.6
11/14/91	9	nd	ndet	nd	7.2	4.5	5	nd	1.7	0.6	1.2	0.8	0.2	0.23

nd= no data

ndet= not detectable

Table 5. Blow-Me-Down watershed water quality data compared to U.S. Environmental Protection Agency water quality criteria.

Water Quality Parameter	Blow-Me-Down Range ^a	EPA Criteria ^b	
		Acute	Chronic
pH	6.6 - 7.9		6.5 - 9.0
Total Iron (mg/L)	0.13 - 2.8	-	1.0
Chloride (mg/L)	1 - 57	860	230
Total Chromium (µg/L)	0.6 - 1.3	1700	210
Total Nickel (µg/L)	0.4 - 1.2	1400	160
Total Copper (µg/L)	0.8 - 7.1	18	12
Total Lead (µg/L)	0.2 - 1.1	83	3.2
Total Cadmium (µg/L)	0.09 - 0.23	3.9	1.1

^a Data presented are a range from all sample dates and all stations combined.

^b Acute criteria are a 1-hour average not to be exceeded more than once every three years on average.

Chronic criteria are the highest instream concentration consisting of a 4-day average not to be exceeded more than once every three years on average.

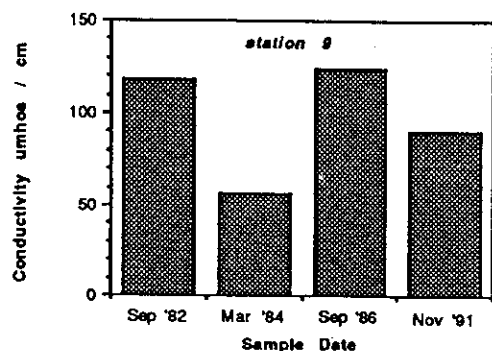
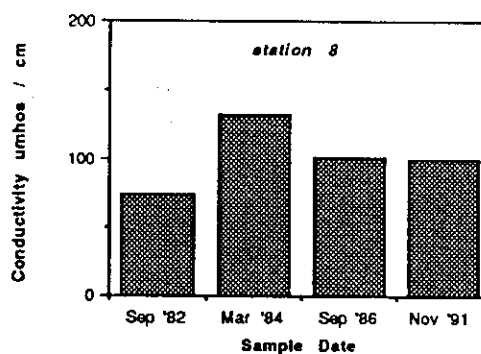
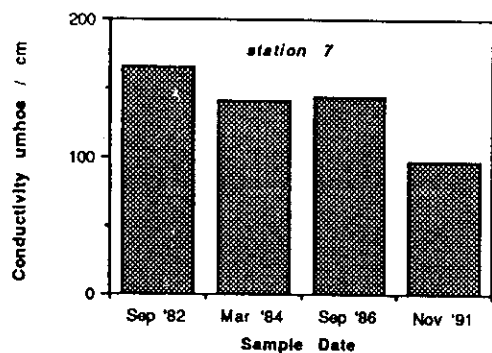
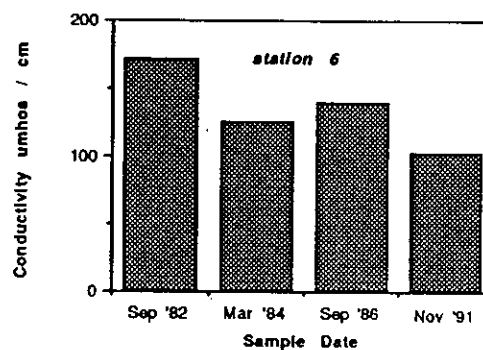
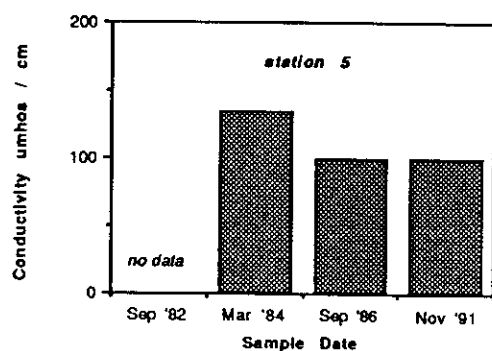
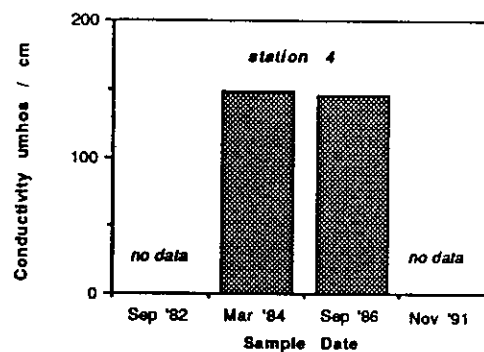
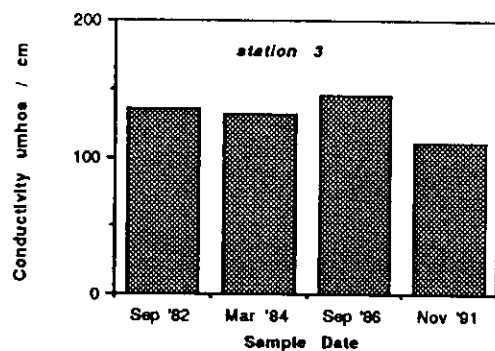
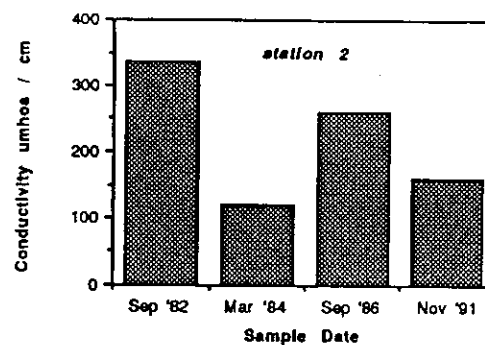
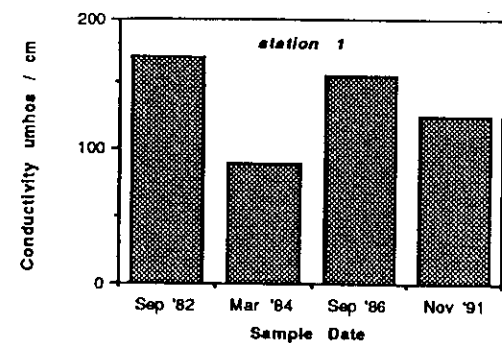


Fig. 1. Conductivity throughout the Blow-Me-Down watershed from 1982-1991.