GROUNDWATER QUALITY STUDY FOR BULLHEAD CITY AND NORTHERN MOHAVE VALLEY, ARIZONA

VOLUME 1

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ABSTRACT

The Arizona Department of Environmental Quality was prompted to conduct a groundwater quality study by concern over nitrate concentrations in groundwater. The study covered the area from the north boundary of Bullhead City south to a point opposite Needles, California, bounded on the west by the Colorado River, and east to the base of the Black Mountains.

This report presents the results of water quality analyses on fifty-two wells and two surface water locations. Water samples were collected and tested for Safe Drinking Water (SDW) inorganics and metals, Volatile Organic Compounds (VOC's), pesticides, and herbicides.

Groundwater quality in the Northern Mohave Valley, although influenced by hydrogeologic conditions, has been to a large extent impacted by the people who live there. Groundwater was found to have elevated nitrate values with 18 wells with concentrations above background (3 mg/l), and 3 wells with concentrations above the maximum contaminant levels (10 mg/l). Also, numerous wells have been noted with elevated chlorides, sulfates and Total Dissolved Solids (TDS) which are representative of septic tank leachate. There appears to be a direct correlation between elevated nitrate values and more densely populated areas that have been impacted by on-site septic systems, and not in agriculture areas.

Elevated arsenic levels in groundwater, have been noted and are of great concern due to the adverse health effects. The arsenic in this area is most probably natural in origin, but the extent of contamination was not determined in this study.

Areas of concern include the Riviera area, Old Bullhead City, north Mesa area, and section B(20,22)26. Recommendations include: 1) a continuation of groundwater monitoring for the study area and areas of new development; 2) the state should assist in the formation of sanitary districts for the area; 3) the extent of arsenic contamination should be determined; 4) and public outreach on the results of this study.

INTRODUCTION

The objectives of this study were to compile existing groundwater data, assess current groundwater quality, and identify possible contaminants that may cause or contribute to the deterioration of the regional aquifer water quality in the North Mohave Valley Area.

In order to characterize the aquifer, it was necessary to determine seasonal fluctuations in water usage, potential contributing factors to groundwater degradation, and interrelationships between surface water and groundwater. It was also necessary to quantify the extent of any contaminants identified in the region, and look at any contaminant trends, spatially and temporally, that may indicate or predict problems in the future.

SECTION 1 SITE DESCRIPTION

1.1 Study Area Location

The study area is approximately 165 miles west of Flagstaff, on the western edge of Arizona (Figure 1). The extent of the study area is bounded on the north by the Bullhead City limits north of State Highway 68, south to Needles, California, bounded on the west by the Colorado River, and extends east to the base of the Black Mountains (Figure 2).

In establishing the study area boundaries, it was determined that the Bullhead City incorporated city limits was not sufficient to evaluate the aquifer as a whole, and would not provide sufficient information that would allow the study to provide for the evaluation of the long term surface and groundwater interests of the area.

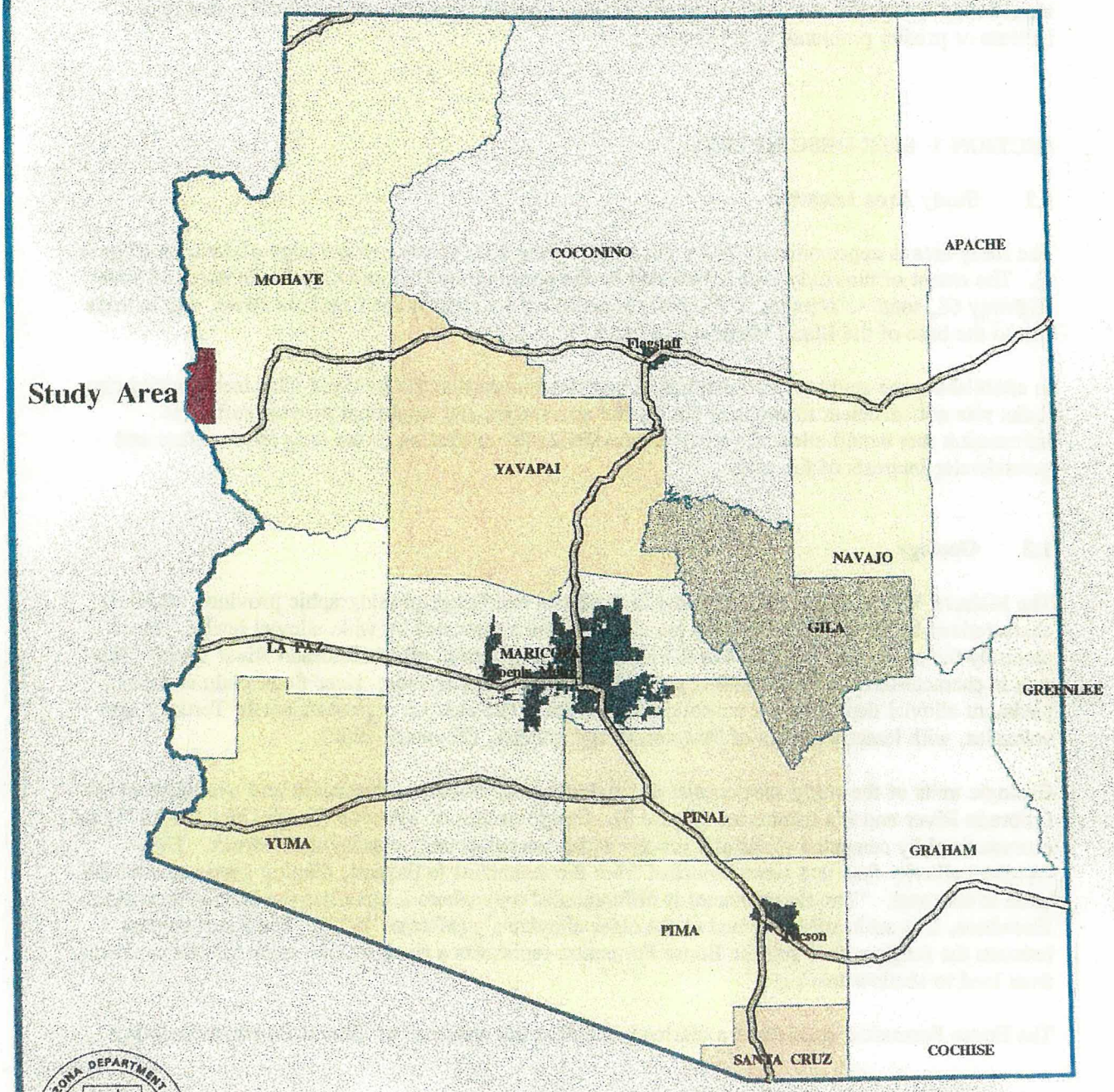
1.2 Geology

The Mohave Valley study area is located in the Basin and Range physiographic province, which is characterized by north-south trending parallel mountains separated by wide alluvial basins. More precisely the study area is located in the Mohave Valley portion of the Colorado River basin. This area is characterized by three distinct geologic features which include: river flood plain deposits, piedmont alluvial deposits, and consolidated bedrock. The bedrock is predominately Tertiary age volcanics, with lesser amounts of Proterozoic age granites, (Reynolds 1988).

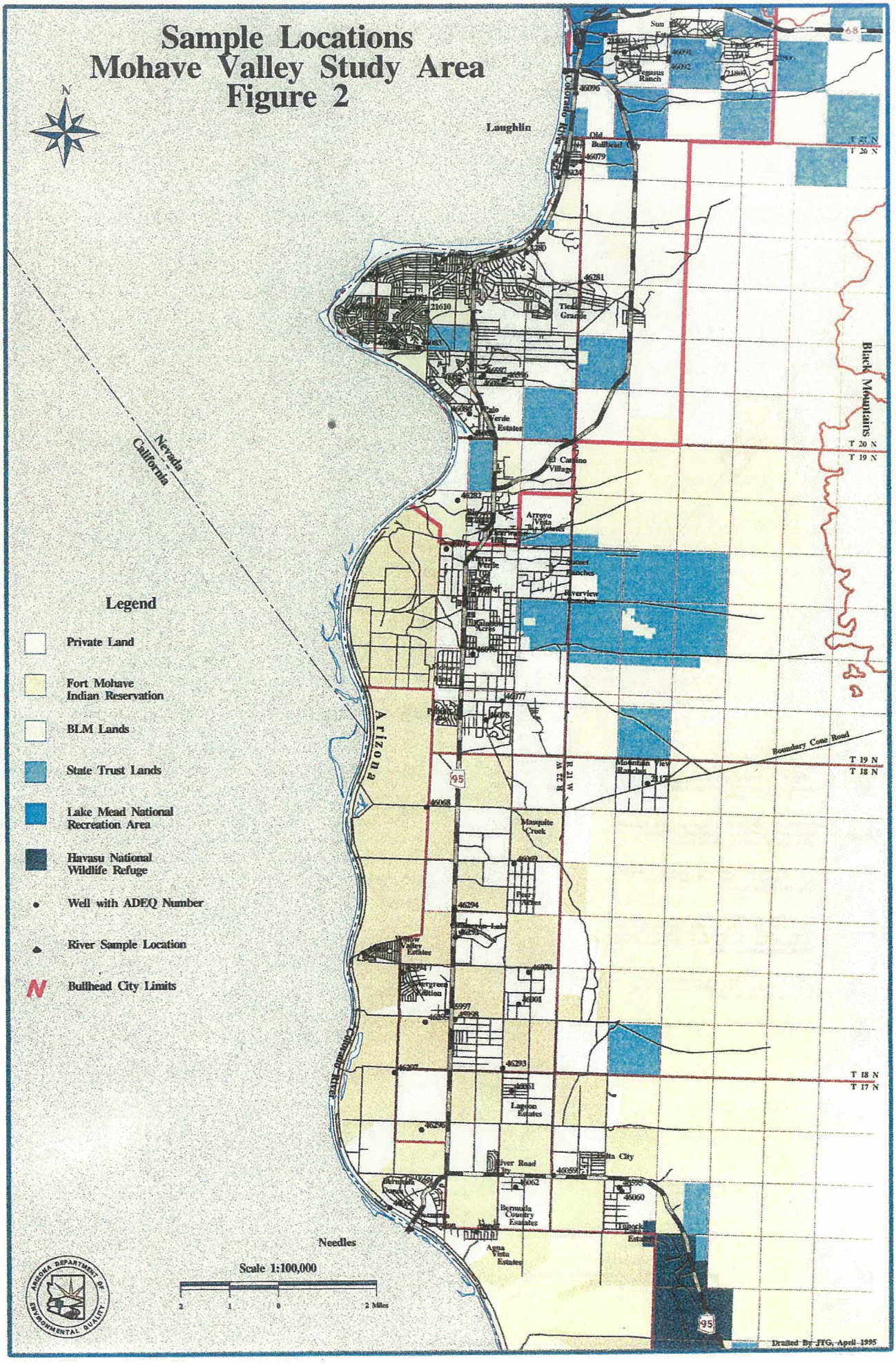
Geologic units of the study area consist of fanglomerates, the Bouse Formation and alluviums of the Colorado River and it's tributaries (Figure 3). Fanglomerates of Miocene (?) age (Metzger 1973) are characterized by cemented sands and gravels which unconformably overlay the bedrock. They represent alluvial fans that were deposited from the mountains to the east, dipping gently toward the basin to the west. "The fanglomerate is differentiated only where it underlies the Bouse Formation. Elsewhere, it is arbitrarily assigned to the older alluviums", (Metzger 1973). The sharp contact between the fanglomerate and the Bouse Formation represents a change in depositional environments, from land to shallow marine.

The Bouse Formation consists of a marine brackish water sequence of three units which include a

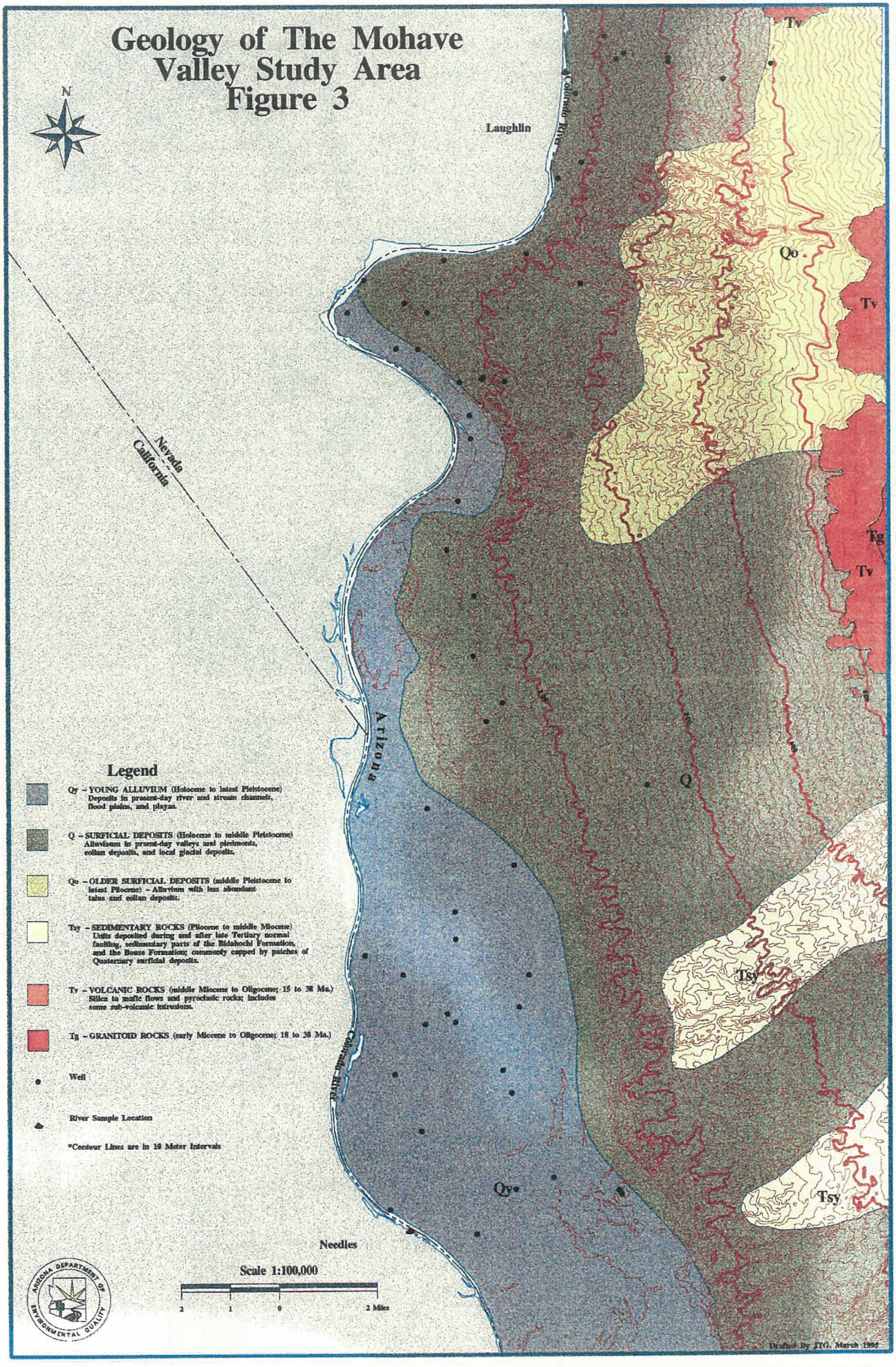
Study Area Location
Figure 1



Sample Locations
Mohave Valley Study Area
Figure 2



Geology of The Mohave Valley Study Area Figure 3



basal limestone, overlain by interbedded clays, silts, sands and a tuff. The Bouse formation is thought to have been deposited in an extensional environment as part of the Gulf of California. The Bouse Formation rests unconformably on the Fanglomerate and is Pliocene in age, (Metzger 1973). Sedimentary parts of the Bouse Formation are described by Reynolds, 1988 as units deposited during and after late tertiary normal faulting, commonly capped by patches of Quaternary surficial deposits.

Alluviums consist of two units: the younger alluviums including younger floodplain deposits, colluviums and wash deposits; and older alluviums of interbedded river sands, silts, clays, gravels and cobbles. Reynolds, 1988, further delineates the older alluviums into two units: surficial deposits, Holocene to middle Pleistocene alluvium in present-day valleys and piedmonts, eolian deposits, and local glacial deposits; and the older surficial deposits, middle pleistocene to latest pliocene alluvium with less abundant talus and eolian deposits. In general the contact between the older and younger alluviums is at the present flood plain of the Colorado River and alluvial slopes.

1.3 Hydrology

1.3.1 Groundwater

The bedrock of the area is assumed to be impermeable and adds no significant impact to the geohydrology of the area, (Metzger 1973). All but a few wells in the study area yield water from the alluvium. The alluvium is a heterogeneous mixture of gravel, sand, silt and clay which yield large amounts of water from relatively shallow wells. Wells that penetrate a significant thickness of gravel from the alluvium are reported to have specific capacities over 100 gpm per foot of draw down, (Metzger 1973). Groundwater in the area exists under unconfined, shallow water table conditions. Locally, groundwater flow is east-southeast away from the Colorado River with a regional flow south-southwest roughly following the axis of the Colorado River.

Recharge to groundwater is from the Colorado River, unused irrigation water, underflow from bordering areas, and runoff from precipitation. Of these the Colorado River is the principle source of recharge to the groundwater system.

1.3.2 Surface Water

The natural condition of flow for the Colorado River is irregular; with lower flows in the fall and winter, and higher flows with strong peak flows in spring and summer. Flow in this reach was natural until the completion of Hoover Dam in February 1935. Flow was further regulated in this reach with the completion of Davis Dam in January 1950. More stringent control of river flow occurred with the closure of Glen Canyon Dam in 1963.

Before the Glen Canyon Dam was completed in 1963, Colorado River quality changed seasonally. Total Dissolved Solids (TDS) in the spring usually ranged between 200-300 mg/L with calcium, bicarbonate, and sulfate always exceeding chloride, while in the winter months TDS ranged between 1500-1800 mg/L comprised predominantly of calcium and sulfate. Sodium and chloride were sometimes present (Metzger 1973). There are no consistent early records of water quality, but it is reasonable that a relationship between water quality and

discharge existed.

Today, flows from the Glen Canyon Dam are controlled. The minimum average daily discharge observed since 1969 has been 1,890 cfs. The maximum average daily discharge during this same period is 46,200 cfs, (Wilson and Garrett 1987). In the earliest period of record, 1905-1907 there were days with no flow, this indicates that there were probably days with no flow in most years prior to regulation. After the closure of Davis Dam there were several days of no flow while Lake Mohave filled to a minimum level of discharge, but this has not occurred since.

An artificially consistent river flow has been created, and seasonal difference in chemical composition of Colorado River water was minimized after the completion of Glen Canyon Dam. TDS now varies very little, annually from 680-740 mg/L, with the ratios between calcium, sulfate, and chloride remaining fairly consistent. This is verified by surface water samples collected for this study in June and December (Appendix A, and Volume 2).

1.4 Land Use

Land ownership in the study area is a combination of private, Indian Reservation, Bureau of Land Management (BLM), State Trust Lands, National Recreational Area (NRA), and National Wildlife Refuge (NWR). This contributes to a highly varied land use for the Mohave Valley Study area (Figure 2).

Land use and the overall county land use zoning for the Mohave Valley Study area appears random, and is a patch work of small subdivisions, agriculture, and undeveloped lands; with a corridor along Interstate Highway 95 of business and light industrial.

The Fort Mohave Indian Reservation is predominantly agriculture. The tribe does have specific proposals and plans for some portions of land to be developed for commercial oriented and recreational uses. Tribal lands are the largest single land area in the valley that can be planned for development. Therefore, the direction and goals of the tribe play a primary role in shaping the future of the southern portion of the Mohave Valley.

BLM lands have very little development. There are a few scattered mining claims and transmission and pipeline rights-of-ways. Grazing is limited in the southern region of the valley. The current grazing program for the "Black Mountain Planning Unit" is a two-phase program. Land south of Boundary Cone Road is reserved for wildlife habitat and will be managed with consideration of the maximum benefits for the wildlife. Land north of Boundary Cone Road is within the Silver Creek grazing allotment, which is classified as an "ephemeral" grazing system: the number of animal units allowed is based on 50% of the estimated carrying capacity of the range conditions, (Mohave Valley North Area Plan 1980).

State Trust Lands managed by the Arizona State Land Department, currently make up approximately 10 percent of the study area. Currently this property does not have an impact on groundwater quality in the area, however, the State Land Department has the authority to sell this land at any time to private parties. These areas remain undeveloped, but have the potential to effect groundwater quality in the future.

The Lake Mead National Recreation Area and the Havasu National Wildlife Refuge make up a very small portion of the study area to the extreme north and extreme south. These lands are used exclusively for recreation and wildlife management and create no impact on groundwater quality in the area, however, they have a potential to be effected by the planning and zoning of adjacent lands.

1.5 Sewers

Four small sanitary districts are located in the study area: The Fort Mohave Sanitary District, extending from Joy Lane south to the southern limits of the study area; Citizens Utility Certified Wastewater Area, encompassing parts of Riviera and highway 95 northeast of Riviera; City of Bullhead Sanitary District, encompassing the southern city limits and Sun Ridge estates area; and the Bullhead Sanitary District, which serves the Old Bullhead City area.

The Bullhead sanitary district is currently under construction and is slated to go on line in June of 1995. Currently, no sanitary district exists from Joy Lane north to the southern boundary of the Bullhead City Limits. However, a small number of commercial properties are running individual package plants in this area and in other parts of the study area. Of the developed lands in the study area less then 10 percent is sewered and currently on line (Figure 4).

1.6 Soils

Soils in the majority of the Mohave Valley study area are Hyperthermic Arid, mostly of the Laveen-Carrizon-Antho Association, which are soils on dissected terraces and alluvial fans. On the floodplains and lower alluvial fans the Antho-Vint-Gilman Association deep soils are found adjacent to the Colorado River. These soils are up to 60 inches deep and have been formed in recent alluvium, (Mohave Valley North Area Plan 1980).

1.7 Vegetation

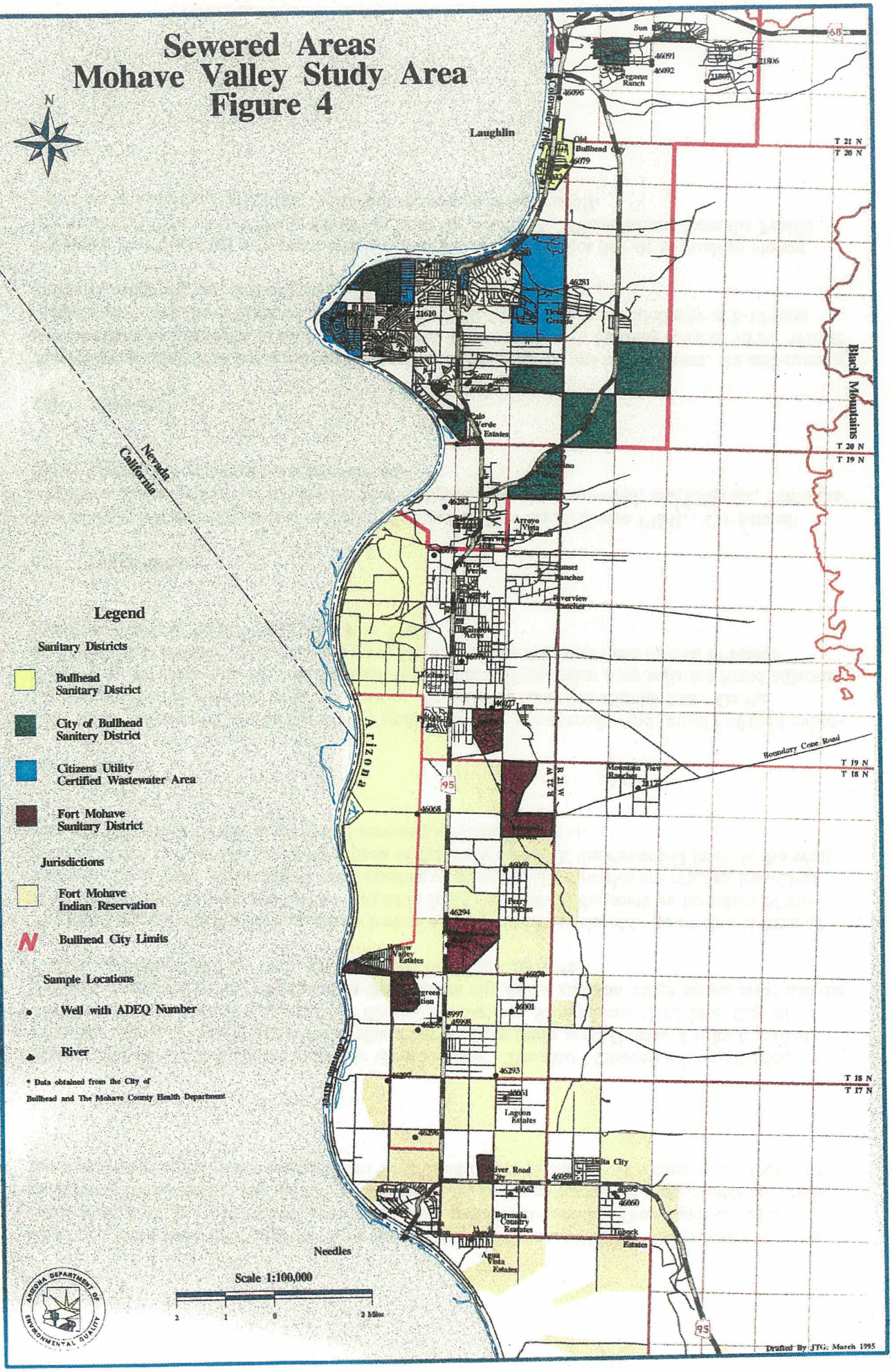
The Mohave Valley study area is in the Lower Sonoran Life Zone, (Lowe 1964). The natural vegetation along the Colorado River includes mesquite, tamarisk, arroweed, and saltgrass, while the desert floor is typical creosote bush scrubland.

1.8 Climate

The Mohave Valley area has a semi-arid climate with mild winter and hot summers. In mid-summer late afternoon temperatures of over 100° Fahrenheit is common, with morning lows of 75°F. Winter temperatures range from highs of 60-70°F to lows of 40-50°F. Winds are southerly at 8-12 mph during the summer, but northerly at 12-24 mph during the winter.

In summer months moist air from the Gulf of Mexico mixes with hot dry air to produce violent thunderstorms with most of the precipitation resulting as runoff. Winter storms from the Pacific Ocean bring a steady soaking rain with more recharge and less runoff.

Sewered Areas
Mohave Valley Study Area
Figure 4



Precipitation ranges from seven inches in areas that are characterized by low altitude and sheltered by the surrounding mountains, and up to ten inches along the mountain ranges to the east, (U.S. Department of Commerce 1994).

SECTION 2 FIELD PROCEDURES

2.1 Field Activities

In February and March of 1994, field reconnaissance was conducted to locate wells and make critical decisions about well suitability and sampling requirements. During the field reconnaissance, Global Positioning System (GPS) locations of potentially suitable wells were gathered along with field parameters (temperature, pH, and electrical conductivity). In June of 1994, fifty wells and two river stations were sampled for Safe Drinking Water (SDW) inorganics and metals, nine wells were sampled for Volatile Organic Compound's (VOC's) and twenty-two wells were sampled for pesticides and herbicides. In late November and December of 1994 fifty-two wells and two river stations were sampled for SDW inorganics and metals, nine wells were sampled for VOC's and twenty-two wells were sampled for pesticides and herbicides. Results of the sampling can be found in Appendix A and in Volume 2. Field parameters (temperature, pH, and electrical conductivity) were recorded and are listed in Appendix B.

2.2 Global Positioning System

Locational data was collected for all wells with the use of Global Positioning System (GPS) field receivers. Differentially corrected GPS locations (with an accuracy of 2-5 meters CEP) for each well are listed in Table 1, and are used for graphical locations of sample points on applicable maps.

Table 1
GPS Locations

ADEQ WELL#	Latitude	Longitude
46077	34°59'50.349"	114°35'00.034"
21177	34°58'32.818"	114°32'01.834"
46066	34°51'23.565"	114°36'55.654"
21610	35°06'14.601"	114°36'45.872"
01280	35°07'16.559"	114°34'48.694"
46282	35°03'08.841"	114°36'01.704"

ADEQ WELL#	Latitude	Longitude
46281	35°06'48.858"	114°33'41.897"
46082	35°05'38.144"	114°37'22.072"
46079	35°08'48.529"	114°33'45.455"
46059	34°52'00.663	114°33'39.545"
46084	35°05'10.976"	114°35'38.142"
46081	35°06'23.299"	114°37'13.679"
46083	35°05'38.400"	114°36'55.597"
46293	34°53'45.717"	114°34'45.356"
46294	34°56'21.311"	114°35'48.952"
46068	34°58'02.467"	114°36'26.917"
46061	34°53'23.371"	114°34'33.822"
46075	35°02'20.007"	114°36'13.537"
46088	35°04'11.133"	114°35'48.812"
46090	35°06'11.795"	114°38'22.036"
46092	35°10'31.692"	114°32'05.472"
46091	35°10'35.322"	114°32'05.494"
46094	35°10'32.769"	114°33'07.511"
46093	35°10'38.919"	114°32'58.608"
21809	35°10'55.116"	114°33'22.329"
21807	35°10'15.993"	114°30'59.218"
21806	35°10'32.645"	114°30'01.967"
46060	34°51'46.714"	114°32'16.803"
46067	34°51'02.439"	114°35'10.365"
46001	34°54'49.624"	114°34'28.226"
46070	34°55'21.741"	114°34'17.449"
46089	35°06'44.627"	114°38'03.340"
46086	35°04'34.163"	114°35'51.002"
46062	34°51'47.548"	114°34'25.075"

ADEQ WELL#	Latitude	Longitude
46069	34°57'09.386"	114°34'39.669"
46078	34°59'31.260"	114°35'18.797"
46074	35°01'35.242"	114°35'38.731"
46080	35°07'07.165"	114°36'28.058"
00324	35°08'32.147"	114°34'13.115"
46096	35°09'56.618"	114°33'55.098"
45997	34°54'40.449"	114°35'54.209"
45998	34°54'32.734"	114°35'44.450"
46292	34°55'54.450"	114°35'47.108"
45994	34°55'17.542"	114°36'49.106"
45999	34°55'35.173"	114°37'35.875"
46076	35°00'35.953"	114°35'37.425"
46085	35°05'07.050"	114°36'04.557"
46295	34°54'29.398"	114°36'20.306"
46297	34°53'38.220"	114°36'55.296"
46296	34°52'41.899"	114°36'20.836"
46597	35°05'12.887"	114°35'35.797"
46596	35°05'09.399"	114°35'10.224"
46595	34°51'50.154"	114°32'19.974"

2.3 Field Measurement and Calibration Procedures

Physical and chemical measurements taken in the field included: temperature, pH, electrical conductivity, depth to water and depth to the bottom of the well (where applicable). Field instruments were checked and calibrated (if applicable) before leaving the office, again in the field before sampling, and intermittently each day. Standards were fresh, and dedicated containers, decontaminated according to standard Quality Assurance Project Plan (QAPP) procedures, were used for field testing.

2.4 Field Notations

A field log book and data sheets were maintained during the sampling period. A bound log book was maintained by field personnel. Information and observations were entered into the field log book. All information was entered at the time of observation and the observation time was noted. All normal and abnormal conditions existing during sampling were recorded in the field log books.

Field sampling data sheets were also completed by field personnel. Information entered on the data sheets included (but was not limited to): sampler's identity, time and date of sampling, weather conditions, sample description, sample location, DEQ sample identification number, well identification, name and address of site/well owner, pertinent site/well information, field meters used and their serial numbers, result of field measurements, appearance of sample, purge method, purge volume, purge rate, sampling method, well construction data, type of analyses requested, Chain of Custody (COC) number, preservation methods, and observations. For monitor wells, depth to water was noted before purging and again before sampling.

SECTION 3 SAMPLING METHODS

3.1 Groundwater

3.1.1 Wells

Shallow wells (< 150 feet below grade) have been selected for this study to evaluate water quality conditions in the uppermost portion of the aquifer where potential contamination of groundwater exists. Shallow wells are better suited to observe impacts from factors such as septic tanks, fertilizer application and urban pollution. Predominantly, domestic and production wells were sampled. Monitor wells were also sampled where available. A few deep wells were used in areas where historical sample data showed the presence of elevated nitrate values, or where no shallow wells existed. Information and locations for these wells are present in Table 2, Wells Sampled, and Figure 2, Mohave Valley Study Area.

Table 2
WELLS SAMPLED

LOCATION	ADWR WELL#	ADEQ WELL#	SURFACE ELEV.(MSL)	WELL DEPTH(ft)	DEPTH TO WATER	MEASUREMENT DATE	WATER ELEV.(ft)	SAMPLE ID	WELL USE
B-17-21 07CC	55-626968	46059	462	280	20	1977	442	MV694-12,MV1294-55	D
B-17-21 17BCC	55-527851	46060	460	76	15	04/23/90	445	MV694-37	D
B-17-22 01BCA	55-516680	46061	465	80	12	02/03/87	453	MV694-24,MV1294-56	D
B-17-22 04AAA	N/A	46297						MV694-63,MV1294-52	D
B-17-22 10BBB	N/A	46296						MV694-65,66,MV1294-53	D
B-17-22 13 BBC	55-650419	46062	465	88	17	06/08/76	448	MV694-45,MV1294-66	D
B-17-22 15CCD	55-648416	46066	470	85	30	1980	440	MV694-04,MV1294-45	D
B-17-22 17CAB	55-532777	46595		80	15	08/24/91		MV1294-65	D
B-17-22 23ABA	55-641954	46067	465	28	10	1973	455	MV694-38,MV1294-69,70	D
B-18-21 05ACC	55-509385	21177	880	460	375	11/06/84	505	MV694-02,MV1294-46	D
B-18-22 10BAA	55-503248	46068	481	65	18	07/09/82	463	MV694-21,22,MV1294-48	D
B-18-22 13BBB	55-522334	46069	475	65	15	09/25/88	460	MV694-46,MV1294-12	D
B-18-22 14CCC	N/A	46294						MV694-20,MV1294-49	D
B-18-22 21DCB	55-603947	45999	477	100	15	1964	462	MV694-58,MV1294-06	P
B-18-22 23BCC	55-604161	46292	474	100	15	1967	459	MV694-56,MV1294-08	P
B-18-22 25BAB	55-600110	46070	473	112	20	1975	453	MV694-40,MV1294-22	D
B-18-22 25CAC	55-523363	46001	470	85	15	03/24/90	455	MV694-39,MV1294-67	D
B-18-22 27BBC	55-603949	45994	479	100	15	1969	464	MV694-57,MV1294-07	P

LOCATION	ADWR WELL#	ADEQ WELL#	SURFACE ELEV.(MSL)	WELL DEPTH(ft)	DEPTH TO WATER	MEASUREMENT DATE	WATER ELEV.(ft)	SAMPLE ID	WELL USE
B-18-22 27DDD	55-603950	45997	478	100	15	1965	463	MV694-54,MV1294-10,11	P
B-18-22 34BAB	N/A	46295						MV694-62,MV1294-50,51	D
B-18-22 35BBB	55-603951	45998	479	100	10	1960	469	MV694-55,MV1294-09	P
B-18-22 36CCC	55-511345	46293		84	10	06/11/85		MV694-19,MV1294-47	D
B-19-22 10ADD	N/A	46282		51	23	03/17/94		MV694-08,MV894-04 MV1294-28	P
B-10-22 14CCD	55-642478	46074	575	112	20	08/06/80	555	MV694-48,MV1294-68	D
B-19-22 15ABA	55-505320	46075	550	115	84	06/04/83	466	MV694-25,MV1294-04	D
B-19-22 26BBD	55-527523	46076	549	110	85	03/27/90	464	MV694-59,MV1294-24	D
B-19-22 26DCD	55-507171	46077	575	135	101	02/16/84	474	MV694-01,MV1294-05	D
B-19-22 35BAD	55-523024	46078	550	120	72	01/05/89	478	MV694-47,MV1294-25	D
B-20-22 01DAC	55-512175	46079	600	130	115	09/23/85	485	MV694-11,MV1294-20,21	M
B-20-22 01CDD	55-607020	00324	515	50	35	09/16/81	480	MV694-51,MV1294-60,61	D
B-20-22 13DDD	N/A	46281						MV694-09,MV1294-29 MV295-06	D
B-20-22 16AAB	55-515799	01280	620	150	63	04/09/86	557	MV694-07,MV894-03 MV1294-40,41	M
B-20-22 17BBD	55-517150	46080	520	80	25	03/16/87	495	MV694-49,MV1294-27	D
B-20-22 19ABC	55-602231	46081	530	71	45	07/31/78	485	MV694-14,15,MV1294-19	D
B-20-22 19ADA	55-603474	21610	548	101	50		498	MV694-05, MV894-01 MV1294-38	P
B-20-22 19CDC	55-641497	46082	510	61				MV694-10,MV1294-17	D

LOCATION	ADWR WELL#	ADEQ WELL#	SURFACE ELEV.(MSL)	WELL DEPTH(ft)	DEPTH TO WATER	MEASUREMENT DATE	WATER ELEV.(ft)	SAMPLE ID	WELL USE
B-20-22 19DCD	55-642105	46083	510	71	25	02/15/77	485	MV694-16,MV1294-15	D
B-20-22 26CDC	55-806251	46084	560	140	110	1970	450	MV694-13,MV1294-01 MV295-07	D
B-20-22 26DCD	55-504216	46596		275	215	12/22/82		MV1294-59,MV295-04,05	D
B-20-22 26CAA	55-642369	46597		160	100	1970		MV1294-58,MV295-08	D
B-20-22 29CAD	55-505478	46086	500	86	15	06/03/83	485	MV694-43,44,MV1294-57	I
B-20-22 29DBA	55-637323	46085	555	120	100	09/15/79	455	MV694-61,MV1294-23 MV295-01	D
B-20-22 32DCD	55-644518	46088	490	64	17	07/25/63	473	MV694-27,MV1294-02	D
B-20-23 13DBD	55-641104	46089	495	60	23	1960	472	MV694-42,MV1294-13	D
B-20-23 24BAD	55-509401	46090	510	60	15	10/12/84	495	MV694-28,MV1294-16	D
B-21-21 27CCB	55-805518	21807	1240	1080	735		505	MV694-34,35,MV1294-32	P
B-21-21 27ADD	55-805519	21806	1430	1300	930	05/10/69	500	MV694-36,MV1294-30,31	P
B-21-21 29ADD	55-507875	46091	980	680	470	03/25/85	510	MV694-30,MV1294-33	P
B-21-21 29BCA	55-608741	46093	770	336	246	05/23/70	524	MV694-32,MV1294-36	P
B-21-21 29BCC	55-608740	46094	730	273	201	03/69	529	MV694-31,MV1294-35	P
B-21-21 29ADD	55-507876	46092	980	805	493	08/21/92	487	MV694-29,MV1294-34	P
B-21-21 30AAB	55-620581	21809	670	236	164	02/13/73	506	MV694-33,MV1294-37	P
B-21-22 31BAC	55-536947	46096	545	50	38	10/07/92	507	MV694-53,MV1294-64 MV295-03	M

M = Monitor Well D = Domestic Well P= Production Well I = Irrigation Well N/A = Information not available

3.1.2 Water Quality Parameters Analyzed

Groundwater in the study area has a potential to be impacted by excess discharges from septic systems, application of pesticides and herbicides and non-point source overland runoff. Therefore, to complete the study in a cost effective manner chemicals were selected that address groundwater quality relevant to drinking water standards.

All wells were sampled for SDW inorganics and metals. Select wells (wells which are located in areas of industrial or agricultural influences), were sampled for VOC's and/or pesticides and herbicides respectively. Table 3 outlines the sample parameters for each well. Samples were analyzed in accordance with all State (QAPP) and Federal (EPA) protocols.

Table 3
Water Quality Parameters Analyzed for Samples

ADEQ#	June Sample #	December Sample #	SAMPLE PARAMETERS
46077	MV694-01	MV1294-05	SDW Inorganics
21177	MV694-02	MV1294-46	SDW Inorganics, Pest/Herb
46066	MV694-04	MV1294-45	SDW Inorganics, Pest/Herb
21610	MV694-05	MV1294-38	SDW Inorganics, BTEX
01280	MV694-06	MV1294-40,41	SDW Inorganics
46282	MV694-08	MV1294-28	SDW Inorganics
46281	MV694-09	MV1294-29	SDW Inorganics
46082	MV694-10	MV1294-17	SDW Inorganics, BTEX
46079	MV694-11	MV1294-20,21	SDW Inorganics, BTEX
46059	MV694-12	MV1294-55	SDW Inorganics, Pest/Herb
46084	MV694-13	MV1294-01	SDW Inorganics
46081	MV694-14,15	MV1294-19	SDW Inorganics, BTEX
46083	MV694-16	MV1294-15	SDW Inorganics, BTEX
46293	MV694-19	MV1294-47	SDW Inorganics, Pest/Herb

46294	MV694-20	MV1294-49	SDW Inorganics, Pest/Herb, BTEX
46068	MV694-21,22	MV1294-48	SDW Inorganics, Pest/Herb, BTEX
46061	MV694-24	MV1294-56	SDW Inorganics, Pest/Herb
46075	MV694-25	MV1294-04	SDW Inorganics
46088	MV694-27	MV1294-02	SDW Inorganics
46090	MV694-28	MV1294-16	SDW Inorganics
46092	MV694-29	MV1294-34	SDW Inorganics
46091	MV694-30	MV1294-33	SDW Inorganics
46094	MV694-31	MV1294-35	SDW Inorganics
46093	MV694-32	MV1294-36	SDW Inorganics
21809	MV694-33	MV1294-37	SDW Inorganics
21807	MV694-34,35	MV1294-32	SDW Inorganics
21806	MV694-36	MV1294-30,31	SDW Inorganics
46060	MV694-37	NA	SDW Inorganics, Pest/Herb
46067	MV694-38	MV1294-69,70	SDW Inorganics, Pest/Herb
46001	MV694-39	MV1294-67	SDW Inorganics, Pest/Herb
46070	MV694-40	MV1294-22	SDW Inorganics, Pest/Herb
46089	MV694-42	MV1294-13	SDW Inorganics
46086	MV694-43,44	MV1294-57	SDW Inorganics, Pest/Herb
46062	MV694-45	MV1294-66	SDW Inorganics, Pest/Herb
46069	MV694-46	MV1294-12	SDW Inorganics, Pest/Herb
46078	MV694-47	MV1294-25	SDW Inorganics
46074	MV694-48	MV1294-68	SDW Inorganics
46080	MV694-49	MV1294-27	SDW Inorganics
00324	MV694-51	MV1294-60,61	SDW Inorganics, BTEX
46096	MV694-53	MV1294-64	SDW Inorganics, BTEX
45997	MV694-54	MV1294-10,11	SDW Inorganics, Pest/Herb
45998	MV694-55	MV1294-09	SDW Inorganics, Pest/Herb

46292	MV694-56	MV1294-08	SDW Inorganics, Pest/Herb
45994	MV694-57	MV1294-07	SDW Inorganics, Pest/Herb
45999	MV694-58	MV1294-06	SDW Inorganics, Pest/Herb
46076	MV694-59	MV1294-24	SDW Inorganics
46085	MV694-61	MV1294-23	SDW Inorganics
46295	MV694-62	MV1294-50,51	SDW Inorganics, Pest/Herb
46297	MV694-63	MV1294-52	SDW Inorganics, Pest/Herb
46296	MV694-65,66	MV1294-53	SDW Inorganics, Pest/Herb
46597	NA	MV1294-58	SDW Inorganics
46596	NA	MV1294-59	SDW Inorganics
46595	NA	MV1294-65	SDW Inorganics, Pest/Herb

3.1.3 Well Purging

Prior to well purging, the volume of well water to be purged was determined by data from the Arizona Department of Water Resources (ADWR) well registration database. It was necessary to purge a minimum of three well volumes of water to ensure that stagnant water was removed and replaced by formation water. To ensure that proper volumes of water were purged; temperature, pH, and electrical conductivity were monitored during purging until measurements remained stable within a 10% error. It was important to avoid over-purging and excessive pumping rates in order to collect a representative sample from the aquifer.

Domestic and irrigation water wells were purged with a dedicated submersible pump where available. Monitor wells were purged by either lowering a submersible pump into the well at a depth to ensure adequate purging of the well, or by hand bailing. The volume of evacuated well water was measured by a graduated five gallon bucket and timed to determine the purge rate and proper purge volumes.

3.1.4 Well Sampling

Domestic and other production water wells were sampled from a dedicated spigot as close to the well head as possible to ensure a representative sample. When sample bottles could not be filled directly from a spigot, a Teflon hose was attached to the spigot and used to fill sample bottles. For wells sampled for pesticides and herbicides, if the sample bottles could not be filled directly, a brown glass amber bottle was repeatedly filled and the contents transferred to the sample container. Each monitor well was sampled with a Teflon bailer. The bailer was attached to a nylon line sufficient in length to reach the desired sample depth.

Care was taken to lower the bailer into the water with out excessive agitation and to ensure that the nylon line did not contact the ground surface.

3.2 Surface Water

3.3.1 Colorado River

The Colorado River is a major source of groundwater recharge for the area, and therefore it was decided to collect two river water samples. One sample was collected at the Route 68 bridge into Laughlin, Nevada and the other sample was collected at the Route 95 bridge into Needles California. The river water samples were collected to assess the impacts of overland runoff, and water usage for the area. These samples will characterize the source of groundwater and provide the up and down stream basis for evaluating river impacts within the northern Mohave Valley.

3.2.2 Surface Water Measurements

On June 8, 1994, in cooperation with the BLM, discharge was measured from the cableway at Needles, CA. Measurement was conducted with a Price AA flow meter.

The elevation of the river was surveyed prior to starting the flow measurements. Then at pre-marked locations, every ten feet across the river, the instrument was lowered to the bottom of the river bed, and then raised 3 feet to conduct the flow rate. This procedure was continued across the width of the river. Upon completion, the river elevation was again surveyed. The data was then tabulated, and the flow rate was calculated to be 11,220 cfs. All other discharge rates were estimated using the USGS Rating Table No. 15.0. Table 4 shows discharge rates for river sample stations for both the June and December sampling events.

Table 4
Colorado River Discharge Rates

Date	Time	Laughlin	Needles
June 8, 1994	10:40		11,220 cfs
June 8, 1994	15:00	23,150 cfs	
December 7, 1994	9:35		6170 cfs
December 7, 1994	10:30	9840 cfs	

3.2.3 Surface Water Sampling

River sample location stations were established equidistant across the river, for both river sample locations. Nine stations were established at the Needles Bridge (the southern sample location), and ten stations at the Bullhead City-Laughlin Bridge (the northern sample location).

At each station the river depth was measured, and the sample was collected using a D-11 depth-integrating sampler. The D-11 sampler is equipped with a non-preserved glass bottle which is lowered to the river bottom. The bottle was opened facing up stream and simultaneously raised at a constant rate, in order to collect a composite graduated sample at each station. The contents were transferred to a one gallon amber glass bottle. The sample process was repeated at each station, while traversing the river from west to east. The composite sample was then transferred to the proper preserved and non-preserved sample containers. Field measurements including pH, conductivity, and temperature were recorded at the time of sampling (Appendix B).

3.3 Quality Assurance/Quality Control

3.3.1 Duplicates

In order to evaluate consistency in the sampling process, laboratory handling, and analytical procedures; duplicate samples were collected at a minimum rate of one field duplicate sample for every ten samples collected. Duplicate samples were collected by splitting sample water equally between two separate sample containers, and submitting the duplicates to the laboratory as "blind" samples. The duplicate analytical results were compared to each other to assess laboratory performance. Duplicates were collected in the same manner as other samples.

3.3.2 Equipment Blanks

One equipment blank per day was collected to ensure that non-dedicated sampling equipment were effectively decontaminated. Equipment blanks were prepared by filling sampling devices with laboratory grade deionized water, and transferred to sample containers. The sample was labeled and shipped to the laboratory in the same manner as all other samples collected.

3.3.3 Trip Blanks

Trip blanks were prepared by the laboratory, labeled, packed, sealed and transported to the field. They remained unopened until submitted to the laboratory. One trip blank per VOC sampling event was submitted.

3.3.4 Decontamination Procedures

Proper decontamination procedures were used to prevent cross-contamination of samples. All field equipment was laboratory cleaned, wrapped, and dedicated to a particular sampling point. The submersible pump was cleaned between each use by filling a 30 gallon pail with tap water and alquinox and pumping the pail dry. The pail was then refilled with tap water and again pumped dry. The outside of the pump and hose was scrubbed clean with an alquinox mixture and rinsed with tap water.

3.3.5 Sample Handling and Identification

The appropriate sample containers were used for each sample collected. Analyses were performed in accordance with the U.S. Environmental Protection Agency (EPA) protocols. The samples were pre-labeled and marked with indelible ink and labeled as follows:

1. Sample Name/Identification Number
2. Analyses to be performed
3. Date and time of sample collection
4. Sample matrix
5. Samplers' names

Chain of Custody (COC) seals were used to seal each individual sample container.

3.3.6 Chain of Custody

A Chain of Custody (COC) form was completed at the end of each sampling event and accompanied all samples transferred to the laboratory. When transferring the samples, the persons relinquishing and receiving the sample noted the time and date and signed each COC form.

3.3.7 Sample Storage

All samples were stored on ice immediately after collection. The samples were maintained at 4°C. The collected samples were shipped in ice chests to the selected analytical laboratory. The ice chests were accompanied with a COC form, documenting the transfer of control of the samples from the sampler to the laboratory.

3.3.8 Verification Samples

Additional samples were collected for verification when: 1. any sample exceeded the MCL, 2. if any parameters were observed in the equipment blank, or 3. if a large increase in any individual parameter was observed between sampling events. Verification samples were collected in August 1994 in response to the June 1994 sampling event, and in February 1995 relating to the December 1994 sampling event. Results of verification samples are tabulated

in Appendix A and laboratory reports are contained in Volume 2.

SECTION 4 RESULTS

4.1 Past Sampling

In November of 1989, ADEQ completed a groundwater quality study of the Bullhead City area. The report was entitled "Groundwater Quality in the Bullhead City area, Mohave County, Arizona". Three separate sampling events were conducted for the study. During the first event in 1987, samples from twenty-two wells were collected. During the second event in 1988, five samples were collected. In the third event in 1989, an additional fifteen samples were collected. In all, thirty-six wells were sampled with three wells sampled on more than one occasion. A total of forty-two samples were collected and analyzed for constituents with primary drinking water maximum contaminant level (MCL) standards and secondary maximum contaminant level (SMCL) drinking water parameters. A copy of this study is included in this report as Appendix C.

A total of seven constituent parameters were detected at levels of concern. Nitrate was detected above background levels (typically 3 mg/L as N) in nine wells and exceeded the MCL (10 mg/L as N) in one additional well. Arsenic was detected at levels above the MCL (0.05 mg/L) in three wells. Chloride exceeded the SMCL (250 mg/L) in fifteen wells. Total Dissolved Solids (TDS) exceeded the SMCL (500 mg/L) in all thirty six wells sampled. Iron exceeded the SMCL (0.33 mg/L) in five wells. Manganese was detected above the SMCL (0.05 mg/L) in ten wells and sulfate was detected at levels above the SMCL (250 mg/L) in twenty four wells. This data is summarized in Table 5.

Table 5
Summary of Previous Sampling Results, 1989
Showing Water Quality Parameters That Exceed MCL or SMCL

Sample ID	Well Owner	Location	Parameter	Result (mg/l)
BHC-3	Richardson	B-20-22 26CDB	Arsenic Chloride TDS Sulfate	0.052 332.00 944.00 1080.00
BHC-4	Proctor	B-20-22 26CCA	Nitrate Chloride TDS	7.92 276.00 837.00
BHC-5	Lewis	B-20-22 26ABD	Arsenic Chloride TDS	0.099 315.00 945.00

Sample ID	Well Owner	Location	Parameter	Result (mg/l)
BHC-6	Riverview	B-20-22 09DCD	TDS Manganese	602.00 0.460
NIS-2		B-20-22 09DCD	TDS Manganese	630.00 0.500
BHC-7*		B-20-22 09DCD	TDS Manganese	604.00 0.450
BHC-8	Palo Verde	B-20-22 32ACC	Chloride TDS Sulfate	346.00 1137.00 280.00
BHC-9	El Rio Motel	B-20-22 09DDA	TDS Sulfate Manganese	552.00 260.00 0.210
BHC-11	BHC Elementary	B-20-22 20BDC	TDS	696.00
BHC-12	Silver Creek	B-20-22 04BAA	TDS	520.00
BHC-13	KOA	B-20-22 13BCA	TDS Sulfate	1027.00 360.00
BHC-14	BHC Mohave High	B-20-22 20ABC	TDS Sulfate	795.00 268.00
BHC-15	Grasse	B-20-22 19CAD	Nitrate TDS Sulfate Manganese	4.60 1046.00 345.00 0.050
BHC-17	Little	B-20-22 19DDD	Nitrate Chloride TDS Sulfate	3.10 560.00 2426.00 942.00
BHC-18	Goad	B-20-22 12BAA	Nitrate TDS Sulfate	7.09 1980.00 774.00
BHC-20	Citizen Utility MH-291	B-20-22 29CCC	Chloride TDS	285.00 800.00
BHC21-1	Sierra WWTP MW-1	B-20-22 16AAB	TDS Manganese	823.00 0.430

Sample ID	Well Owner	Location	Parameter	Result (mg/l)
BHC21-2	Sierra WWTP MW-2	B-20-22 16AAD	Nitrate Chloride TDS Sulfate	4.85 534.00 1690.00 316.00
BHC21-3	Sierra WWTP MW-3	B-20-22 16AAB	TDS Sulfate Manganese	810.00 255.00 0.540
BHC-22	Citizen Utility 16-1	B-20-22 16CCD	Nitrate TDS Sulfate	3.87 1080.00 351.00
BHC-23	Citizen Utility 16-2	B-20-22 16DDD	TDS	733.00
BHC-30	Carefree Resorts	B-20-22 01DAD	Nitrate Chloride TDS Sulfate	8.11 393.00 1370.00 411.00
BHC-35	Rainbow Haven	B-20-22 13BBB1	TDS Sulfate	1200.00 436.00
BHC-36	Citizen Utility Bullhead #4	B-20-22 29ACB	Chloride TDS Sulfate Iron	250.00 1040.00 329.00 1.300
BHC-38	Mohave County Parks	B-20-22 30ADD	TDS Sulfate Manganese Iron	1040.00 423.00 0.484 0.344
BHC-37	Snager	B-19-22 14ABA	Chloride TDS Manganese Iron	770.00 1650.00 0.055 0.386
BHC-39	Mohave Community College	B-19-22 02DDD	TDS Iron	530.00 0.564
BHC-40	Moore	B-20-22 09DDA	TDS Sulfate Manganese Iron	830.00 310.00 0.693 0.625

Sample ID	Well Owner	Location	Parameter	Result (mg/l)
AV-34	Citizen Utility Riviera	B-20-22 19ADA	Nitrate Chloride TDS Sulfate	5.87 370.00 1390.00 424.00
AV-35	Citizen Utility Riverbend #2	B-20-22 24ADA	TDS	580.00
AV-36	Citizen Utility	B-20-22 01DAD	Nitrate Chloride TDS Sulfate	7.65 400.00 1330.00 330.00
AV-37	El Rio Motel	B-20-22 09DAD1	TDS Manganese	570.00 0.689
AV-39	Brown	B-19-22 14DCB	Chloride TDS Sulfate Manganese	350.00 1250.00 344.00 0.060
AV-40	Bermuda Water	B-19-22 14CAC	Chloride TDS Sulfate	250.00 990.00 273.00
AV-41	Bermuda Water	B-19-22 14CAC	Chloride TDS Sulfate	250.00 980.00 273.00
AV-42	Bermuda Water	B-19-22 26ABA	TDS Sulfate	870.00 256.00
AV-43	Bermuda Water	B-19-22 23BBB	TDS Sulfate	840.00 279.00
AV-38	Super-8 Motel	B-20-22 01DA	Nitrate Chloride TDS Sulfate	10.70 360.00 1290.00 258.00
BHC-28	Super-8 Motel	B-20-22 01DA	Nitrate Chloride TDS Sulfate	15.90 408.00 1680.00 263.00

Sample ID	Well Owner	Location	Parameter	Result (mg/l)
NIS-1	Super-8 Motel	B-20-22 01DA	Nitrate Chloride TDS Sulfate	12.10 459.00 1520.00 268.00
BHC-29*	Super-8 Motel	B-20-22 01DA	Nitrate Chloride TDS Sulfate	14.40 646.00 1690.00 256.00

*** indicates a duplicate sample**

4.2 June Samples, 1994

In June 1994, fifty wells and two river stations were sampled by ADEQ for Safe Drinking Water (SDW) inorganics and metals. Nine wells were sampled for VOC's and twenty-two wells were sampled for pesticides and herbicides. The laboratory holding time was exceeded on five of the pesticide/herbicide samples, this data was disregarded for this report.

A total of seven constituent parameters were detected at levels of concern. Nitrate was detected above background (defined as 3 mg/L as N) in seventeen wells and exceeded the MCL (10 mg/L as N) in two additional wells. Arsenic was detected at levels above the MCL (0.05 mg/L) in two wells. Chloride exceeded the SMCL (250 mg/L) in twenty-one wells, TDS exceeded the SMCL (500 mg/L) in forty-three wells, iron exceeded the SMCL (0.33 mg/L) in fourteen wells, manganese was detected above the SMCL (0.05 mg/L) in twelve wells and sulfate was detected at levels above the SMCL (250 mg/L) in eleven wells. Sampling data for 1994 is summarized in Appendix A, and laboratory reports in Volume 2.

4.3 December Samples, 1994

In late November through December, ADEQ sampled fifty-two wells and two river stations for SDW inorganics and metals. Nine wells were sampled for VOC's. Twenty-two wells were sampled for pesticides and herbicides. Analytical results are tabulated in Appendix A.

We were not able to gain access to well 46060 in section B(17,21)17BCC which was sampled in June. However, an adjacent property owner allowed us access to a well that was within 100 yards of the original well. Sampling this well as a substitute had no effect on the quality of the study results.

Two additional wells in section B(20,22)26 were sampled. This allowed us to look at additional wells in close proximity to a previously sampled well. This assisted in looking at contaminant trends for a specific region, that is, to look at a particular area and gauge the constituency of water quality results. This area, along with other sampled wells in close proximity to each other, does in fact indicate that

the data does represent regional conditions, and that limited regional interpretation can be applied to the data with some degree of confidence.

A total of nine constituent parameters were detected at levels of concern. Nitrate was detected above background (typically 3 mg/L as N) in eighteen wells and exceeded the MCL (10 mg/L as N) in three wells. Arsenic was detected at levels above the MCL (0.05 mg/L) in three wells. Benzene was detected at levels above the MCL (5.0 ug/L) in one well. Chloride exceeded the SMCL (250 mg/L) in twenty-five wells, TDS exceeded the SMCL (500 mg/L) in forty-nine wells. Iron exceeded the SMCL (0.33 mg/L) in twenty wells. Fluoride was detected above the SMCL (2.0 mg/L, but below the MCL of 4.0 mg/L) in five wells. Manganese was detected above the SMCL (0.05 mg/L) in twenty-seven wells, and sulfate was detected at levels above the SMCL (250 mg/L) in forty wells. Sample results are tabulated in Appendix A, with laboratory reports in Volume 2.

4.4 Analytical Check

As a check on the consistency and validity of analytic results a standard hydro-chemistry procedural check was sought for this study.

Major Cation-Anion Balance checks are a standard practice for the checking of analyses for water samples where relatively complete analyses are made. The anion-cation sums, when expressed in milliequivalent per liter, must balance because all natural waters are electrically neutral. The test is based on the percentage difference defined as follows: % difference = (cation sum - anion sum)/(cation sum + anion sum) * 100. The details for this check are in Appendix D.

The Cation-Anion Balance checks for this study are further discussed in Section 5.3 of this report.

4.5 NITRATE

4.5.1 Background

Nitrate is one of the inorganic contaminants of concern in the Safe Drinking Water Act passed by congress to assure the protection of the nation's drinking water supplies and public health. The major health hazard associated with high nitrate levels in drinking water is infantile methemoglobinemia (blue baby syndrome). This is a blood disorder which impedes the oxygen carrying capacity of hemoglobin. Blue baby syndrome derives its name from the blue coloration of the skin, which is the first clinically detectable sign of the blood disorder. The blue color generally occurs when ten percent of the hemoglobin is in the methemoglobin form. This does not effect children over three months and adults, since they have a lower pH in their upper gastrointestinal tract which inhibits bacterial conversion of nitrate to nitrite, (Investigative Study of Nitrates in Arizona, 1979). Methemoglobinemia is rarely seen in adults, but pregnant women, people with genetic deficiency of glucose-6-phosphate dehydrogenase or erthrocytic methemoglobin reductase or NADH, and those with achlorhydrosis, from either treatment of peptic ulcers or from chronic gastritis or pernicious anemia, are the most likely to develop this response, (Pontius 1993).

Studies underway, in Canada and South Australia, are focused on the possibility of a causal

association between birth defects and nitrate ingestion. There is also concern about carcinogenicity on transformation products, which is the reaction with secondary amines, amides, and carbamates to form N-Nitroso compounds. Several of these compounds are potential carcinogens.

Nitrate concentrations in groundwater are stable under natural conditions, and are found in concentrations of nitrate < 3mg/L as nitrogen (N). Concentrations greater than this level are usually the result of improper disposal of human wastes, mainly septic tanks, industrial and food processing operations, and silvicultural or agricultural activities, (Bouchard 1992).

Nitrate/Nitrite (as N) is of particular concern in this study, due to historical sample results indicating its increasing presence in several wells in the area (Appendix C).

4.5.2 Observations

In the 1989 Darr, Groundwater Quality Study of Bullhead City Area, nitrate was detected above background (typically 3 mg/L as N) in nine wells. In the samples collected from wells in the study area in June 1994, seventeen wells had nitrate levels above background (Figure 5), and eighteen wells exceeded background levels in December of 1994 (Figure 6).

In the 1989 report, the MCL for nitrate was exceeded in one well (Appendix C). In June of 1994, during this study, two wells exceeded the MCL for nitrate (Figure 5), and in December three wells were in exceedence (Figure 6).

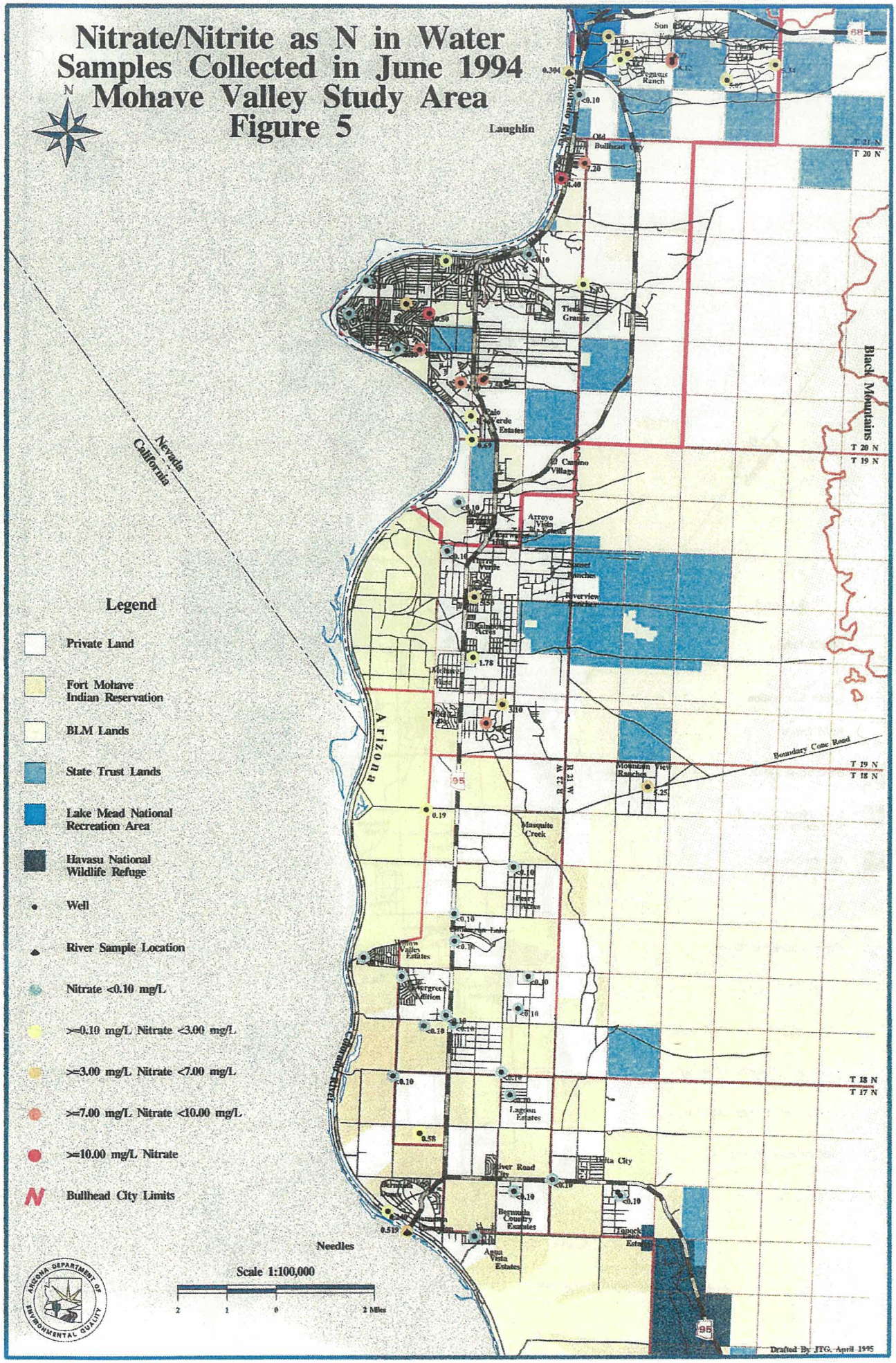
Though the current study encompasses a larger area than the 1989 Bullhead City Nitrate Study, the resultant negative changes of water quality for wells in the original study area are dramatic.

The well that had originally exceeded the MCL in the 1989, with a reported nitrate level of 15.90 mg/L, has demonstrated a dramatic decrease in nitrate levels, through the replacement of the septic systems with a conventional wastewater treatment plant. In June 1994, 7.20 mg/L and in December 1994, 6.06 mg/L nitrate was observed. Though still far above background levels this demonstrates how groundwater quality has improved by the operation of the wastewater treatment facility.

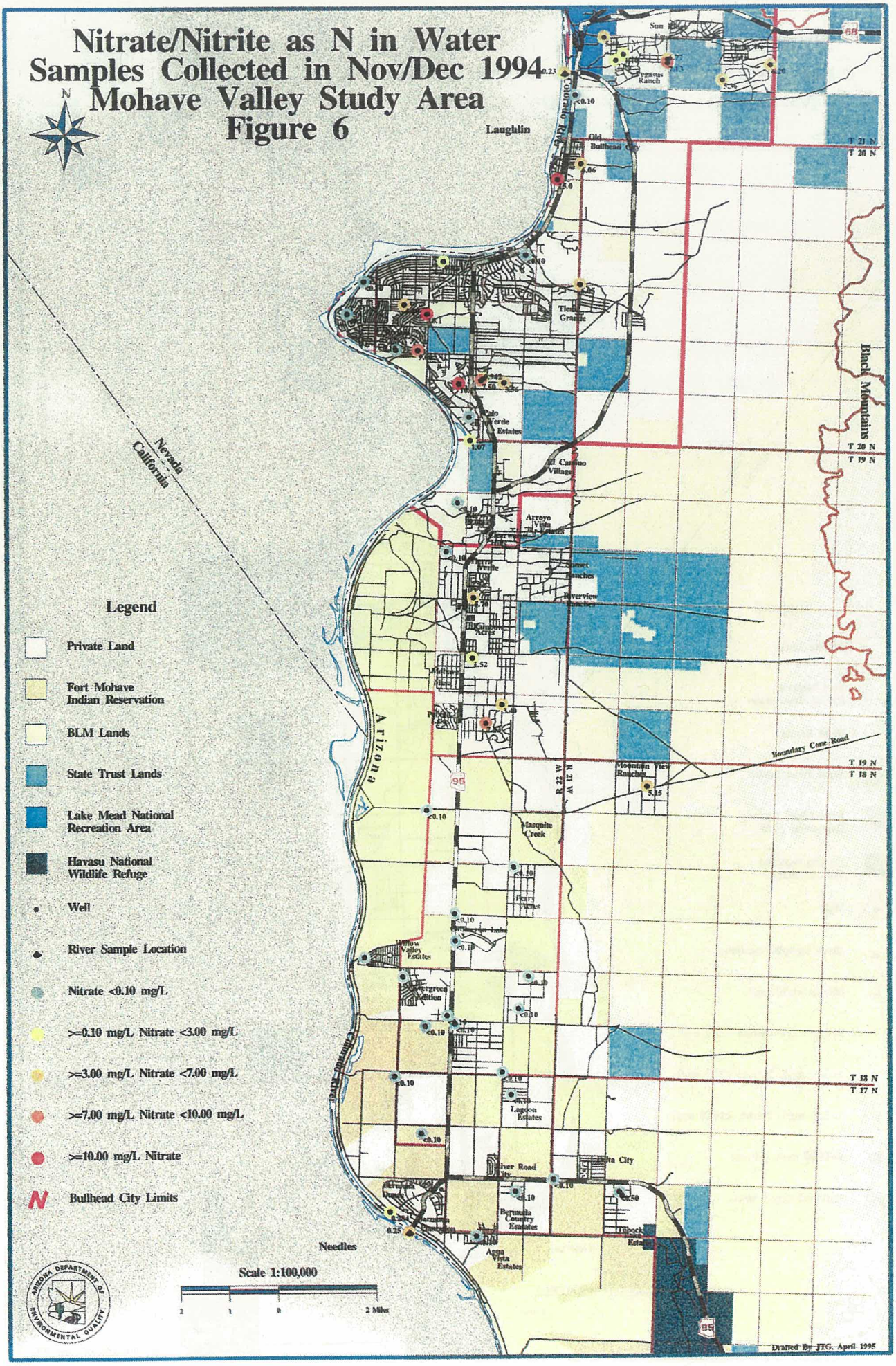
Two new wells are currently in exceedence of the nitrate MCL (Figure 5), as compared to the 1989 study. Well 00324, located at B(20,22)1CDD, had a nitrate level of 7.09 mg/L in 1987, in June 1994 this level was at 14.4 mg/L, and in December 1994 at 15.0 mg/L nitrate. Well 21610, located at B(20,22)19ADA, had concentrations of 5.87 mg/L of nitrate in 1989, and in June 1994 had concentrations of 10.5 mg/L of nitrate. In a five to seven year period nitrate concentrations have doubled in these wells. These wells are no longer a suitable source for drinking water.

In December 1994, an additional well 46085 in section B(20,22)29DBA was identified with nitrate levels exceeding the nitrate MCL (Figure 6). The well had nitrate concentrations with levels of 7.19 mg/L in June 1994, and had increased to 10.1 mg/L nitrate by December 1994.

Nitrate/Nitrite as N in Water Samples Collected in June 1994
Mohave Valley Study Area
Figure 5



Nitrate/Nitrite as N in Water Samples Collected in Nov/Dec 1994
Mohave Valley Study Area
Figure 6



Another area to note is the north Mesa area B(21,21), south of Highway 68 in the northern most part of the study area. Though groundwater depths range from 164 to 930 feet below the ground surface (Table 3), nitrate levels are high. Nitrate was detected in samples collected in this area up to a high of 8.12 mg/L in June 1994 for the middle part of this area in one of the deepest wells. Nitrate levels average from 5.07 mg/L to 6.77 mg/L for both sampling events for the entire Mesa area. This fact possibly demonstrates that large depths to groundwater does not provide adequate protection from nitrate contamination. A lot of new construction was noted in the area during the two sampling events, with most homes being built with septic tanks.

An additional well of concern (related to nitrate) was 46281 located at B(20,22)13DDD. Though the laboratory analysis placed the groundwater quality below the MCL, the change in concentration of nitrate over the two sampling periods was significant. In June 1994, the groundwater sample was analyzed and a result of 1.33 mg/L nitrate was noted, however, the sample collected in December 1994 showed a result of 6.05 mg/L nitrate. This well was resampled by ADEQ to verify the data, and the owner ran an analysis for Total Kjeldahl Nitrogen (TKN), which was positive. This indicated that since the June 1994 sampling, contamination of the well with domestic wastewater had occurred. An investigation into the situation is pending.

Overall, the trend for nitrate levels is increasing in areas of high population densities except where wastewater treatment plants have replaced the use of septic systems. The analytical results of groundwater samples indicate that there is extensive human influence on groundwater by improper disposal of wastes in the Northern two-thirds of the study area. Looking at wells 00324 and 21610, it was observed that areas of high density population and high groundwater nitrate values coincide.

The water samples collected in the lower one-third of the study area are mostly non-detect for nitrate, and in all cases < 1 mg/L nitrate. The land use in the area is predominantly agriculture and is less densely populated, however, new homes are being constructed on a regular basis. It appears that little or no groundwater impact has occurred yet with regards to nitrate in this area.

4.6 ARSENIC

4.6.1 Background

Natural occurrences of arsenic in groundwater with moderate (0.010 - 0.050 mg/L) to high ($>$ 0.050 mg/L) concentrations are common throughout much of the Western United States (Welch 1988). These high concentrations of arsenic are generally associated with one or more of the following geochemical environments: (1) basin-fill deposits of alluvial-lacustrine origin, particularly in semiarid areas; (2) volcanic deposits; (3) geothermal systems, and (4) uranium and gold-mining areas.

Alluvial deposits are an important source of arsenic in groundwater in areas where the sediments are derived from volcanic rocks, and in areas underlain by basin-fill deposits derived from similar sources, such as occurs in the northern Mohave Valley. Arsenic is

particularly associated with volcanic rocks of intermediate to acidic composition.

The geochemistry of arsenic complexes is affected by a variety of processes, such as mineral dissolution-precipitation, oxidation-reduction and adsorption, or biologically mediated reactions. The weathering process may cause arsenic to concentrate in phases such as ferric oxyhydroxide to be deposited with sediments, subsequent dissolution by chemically reduced groundwater could then generate elevated dissolved arsenic.

Mobilization of arsenic may be, in part, a result of changes in the geochemical environment due to changes in recharge, water chemistry, and physical changes in the aquifer. In the deeper subsurface, elevated arsenic concentrations are believed to be associated with compaction caused by groundwater withdrawals (no causal relationship has been established) (Welch, 1988).

Arsenic adversely affects human health and the environment (National Academy of Sciences, 1977). Arsenic has been determined to cause skin cancer with exposure to arsenic concentrations in water, and is suspected to cause cancer in several internal organs by ingestion of arsenic in water. The EPA is currently reviewing the MCL for arsenic, and is under court order to propose a lower MCL from the current 0.05 mg/L in November of 1995, and be in final rule by November 1997 (Reid, 1994).

4.6.2 Observations

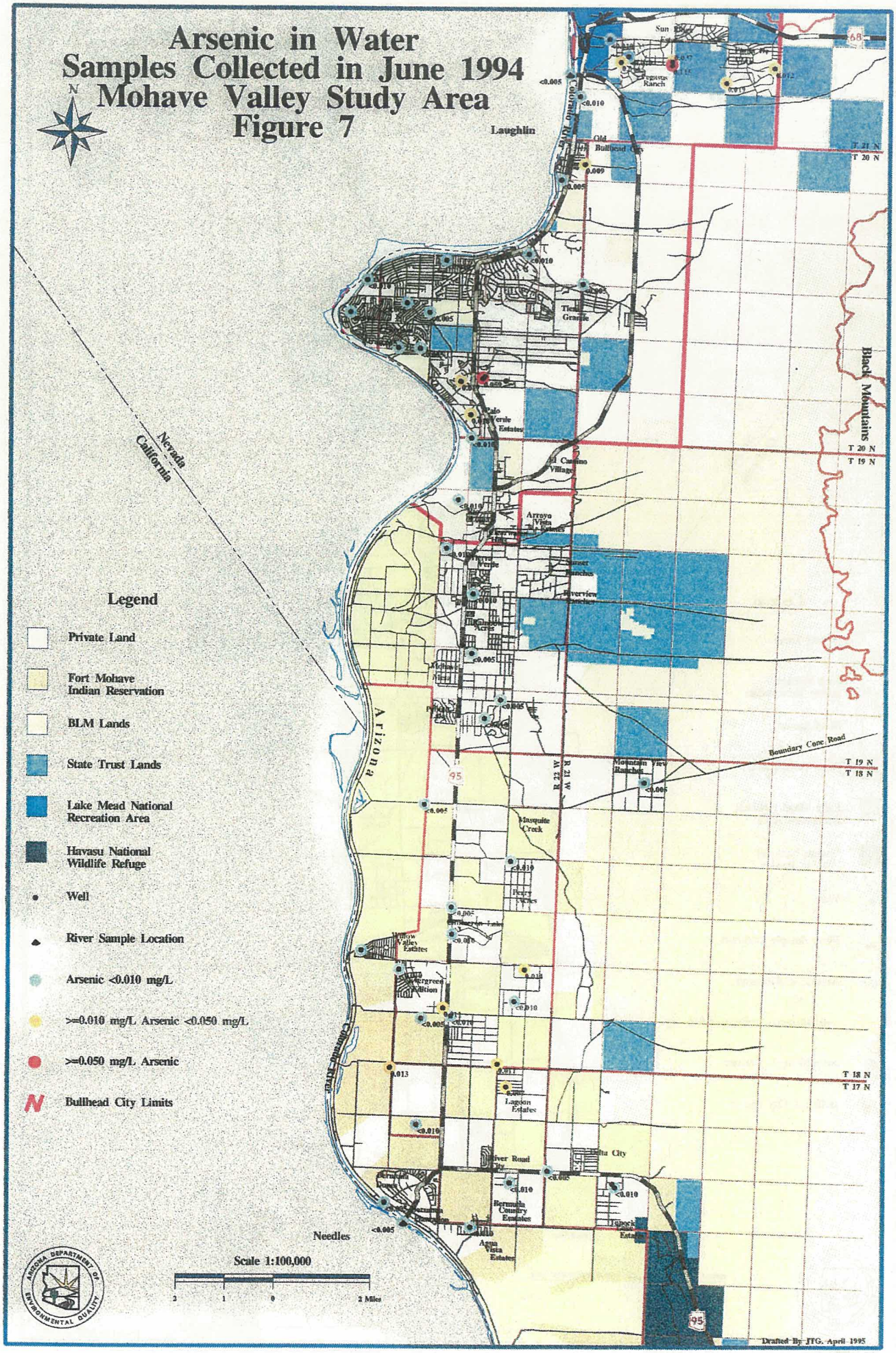
In the 1989 Darr nitrate study of Bullhead City, two wells in section B(20,22)26 were noted to have arsenic levels that exceeded the MCL of 0.05 mg/L (Appendix C). This was interpreted as a natural occurrence, and no further investigation was conducted.

The analytic results of the June 1994 groundwater sampling event indicated that two different wells had detections exceeding the MCL for arsenic in drinking water (Figure 7).

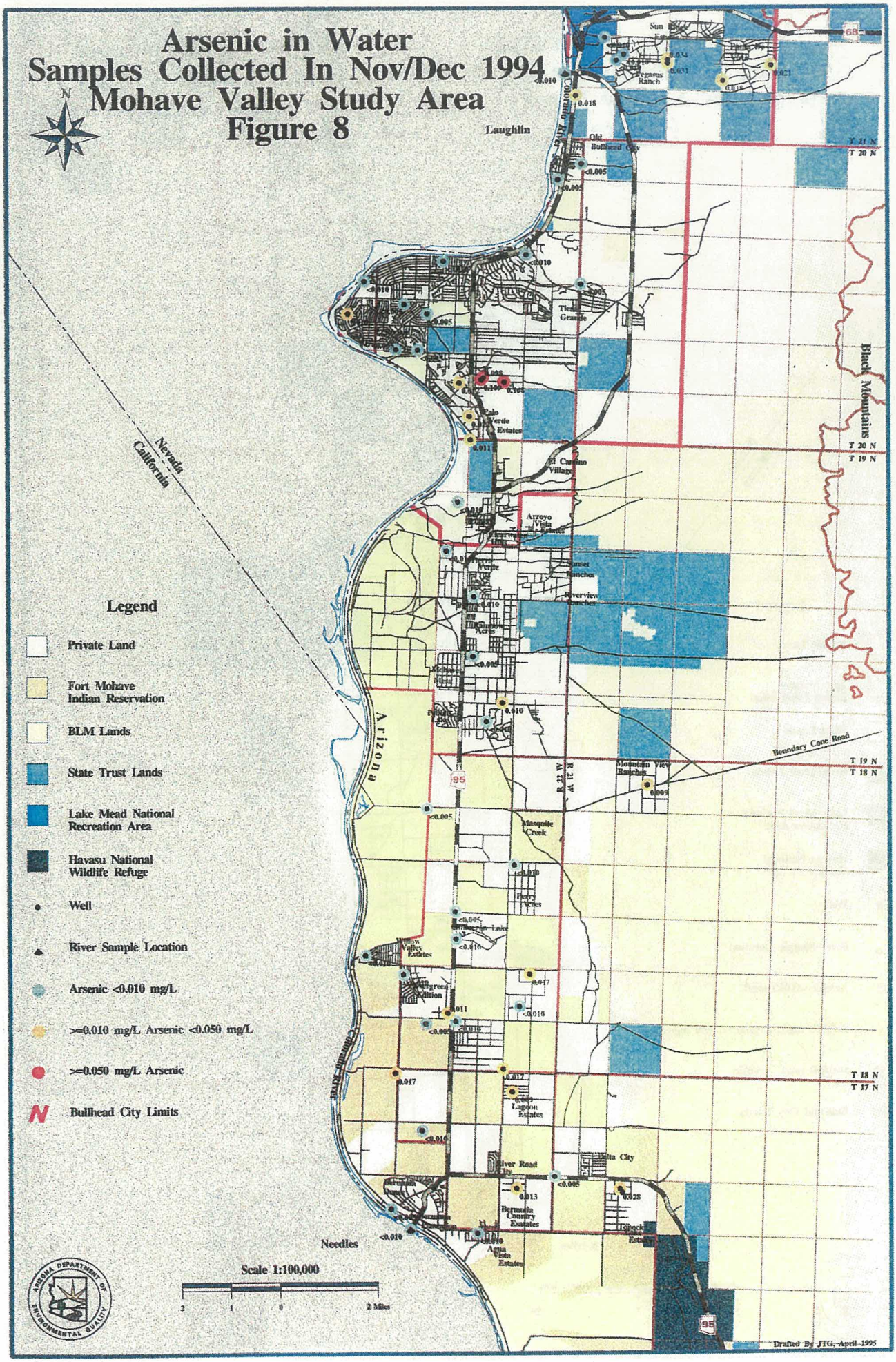
Well 46092 located at B(21,21)29ADD, is in an area outside the original study area. In June, laboratory results indicated an arsenic level of 0.115 mg/L, but in December the sample result was 0.031 mg/L. This well is a high volume production well that currently serves a seasonal population, though more year round residents are moving into the area. Water production for this well is low in June when compared to December. The December level is below the MCL, but still quite high in arsenic, 0.031 mg/L, and has similar arsenic levels as another well in the same section.

Well 46084 located at B(20,22)26CDC exceeding the MCL's in the June 1994 sampling, is in the same section as the wells noted in the 1989 nitrate report. An arsenic level of 0.059 mg/L was obtained from the June 1994 sample, and when resampled in December, the concentration was 0.109 mg/L. This well serves a year round population, and the water use has been reduced due to high nitrate levels detected in the June sampling event. Two additional wells in the same section were sampled and analyzed in December 1994. The analytical results for the December sampling of these wells were 0.098 mg/L and 0.168 mg/L arsenic, respectively (Figure 8). With three wells in close proximity, the study was able to look at the consistency of water quality for the area, and look at contaminant trends. These

Arsenic in Water
Samples Collected in June 1994
Mohave Valley Study Area
Figure 7



Arsenic in Water
Samples Collected In Nov/Dec 1994
Mohave Valley Study Area
Figure 8



results indicate a consistency of water quality results for the area, and also shows a trend of arsenic contamination.

SECTION 5 QUALITY OF GROUNDWATER

5.1 Geologic Interpretation From Well Logs

In general, the geologic interpretation of the Mohave Valley, as interpreted by Metzger and Loetz, was found to be representative of the area geology. It is only in the Riviera area that the contact between the older and younger alluviums is subject to differing interpretation from the authors of this report. Metzger and Loetz had interpreted the contact to be at the river bank. However, they only utilized one well in this area for their regional study to draw their conclusions.

Interpretation of the contact is generally subjective, but by looking at additional well logs of the Riviera area, a subtle difference in the consolidation of alluviums was noted. In general the older alluviums are more consolidated and have limited cementation, while the younger alluviums are less compacted. It is on this compaction and cementation of alluviums, that it was determined that the contact in the southern portion of Riviera was between wells 46082 and 46083 (Figure 3).

This interpretation of alluvium contact is further substantiated by comparing the water chemistry, and water temperatures between these wells. The significant difference in water chemistry within these wells, and also compared with all others in the Riviera area indicate that geology is influencing groundwater quality characteristics. This interpretation mimics Reynolds 1988 Geologic Map, but shifts the contact between the younger and older alluviums in this area approximately 400 meters to the west.

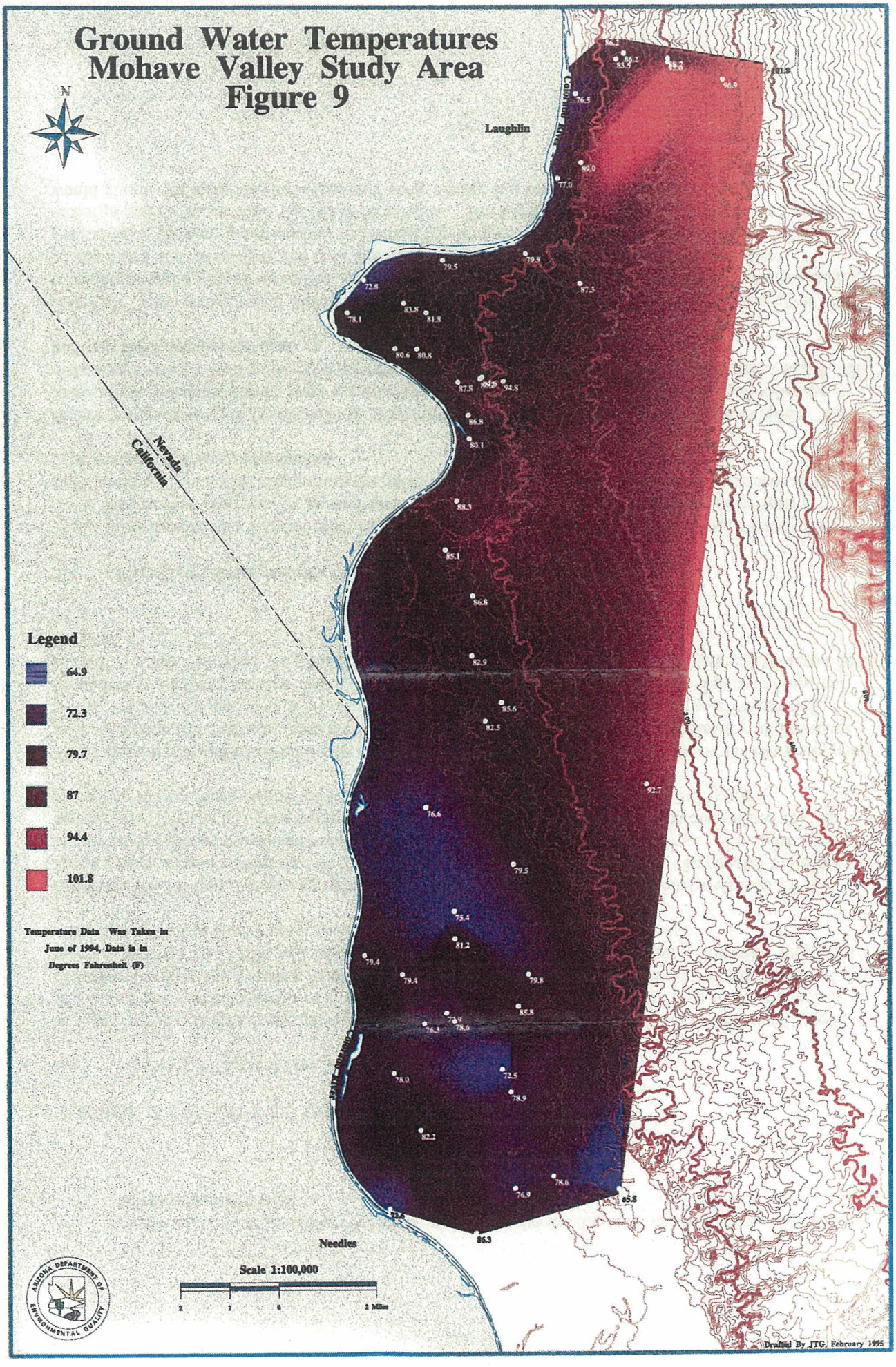
5.2 Hydrologic Interpretation From Groundwater Temperatures

Water temperature data was collected in both the June and December 1994 sampling events. The water temperature reported for groundwater samples is that temperature measured after well stabilization. The water temperature for surface water samples, was a simple measurement of the river water at the sampling station.

Figure 9 was developed from the June 1994 sample temperature results for all water samples. The temperature gradients shown were generated by the Kriging algorithm, which simply divides the difference between each point equidistantly, and has been used to interpolate temperatures which fall between field determined data.

Colorado River water, and groundwater along the river is fairly cool. This indicates that river water is influencing the groundwater in these areas, and is the source for recharge. Water temperature high on the Mesa and away from the river are quite warm, up to 101.8° F. This indicates that groundwater in these areas are less influenced by the river water, and are more likely from local recharge and recharge from the Black Mountains. The temperature variation between these areas would simply indicate varying degrees of river water, and recharge water influences.

Ground Water Temperatures
Mohave Valley Study Area
Figure 9



The temperature model of the June 1994 sample data show temperature gradients that parallel the river and mesas, but also generally mimic surface topography and lithological breaks.

5.3 Cation - Anion Balance

The standard practice for checking groundwater samples, when complete analyses are made, is the major cation - anion balance. It should be noted that potassium (usually a minor constituent) was not analyzed and therefore may distort the analytical check slightly. The anion-cation sums, when expressed in milliequivalent per liter, must balance because all natural waters when in equilibrium are electrically neutral. The test is based on the percentage difference defined as follows: % difference = (cation sum - anion sum)/(cation sum + anion sum) * 100. The table below defines the acceptable % difference:

Anion Sum (meq/L)	Acceptable % Difference
0.0 - 3.0	+/- 0.2 %
3.0 - 10.0	+/- 2.0 %
10.0 - 800	+/- 2.0 to 5.0 %

Cation-anion balance calculations were completed for all samples taken with the exception of samples MV895-01 through MV895-04 due to incomplete sample analysis. The cation - anion balance calculations are tabulated in Appendix D.

Of the fifty six samples that were collected in June of 1994, three (MV694-19,MV694-33, and MV694-53), failed to meet the acceptable percent difference. Sample MV694-19 was collected from a sample spigot after the pressure tank, which may have effected the electrical neutrality of the water. Sample MV694-33 was collected from a production well with an automatic chlorinator. The automatic chlorinator releases chlorine pellets into the well at electronically controlled intervals. Though the automatic chlorinator was turned off, there may have been chlorine left in the well itself, and consequently effected the electrical neutrality of the water. Sample MV694-53 was taken from a monitor well with extremely high turbidity level (345 NTU's) and known contamination, which could suggest that the groundwater is not naturally neutral in this area.

In the December 1994 sampling event, eleven samples collected failed to meet the acceptable percent difference criteria (MV1294-29, MV1294-32, MV1294-33, MV1294-34, MV1294-35, MV1294-36, MV1294-37, MV1294-45, MV1294-46, MV1294-64, and MV1294-68). Sample MV1294-29 upon resampling was determine to have a large increase in nitrate levels and TKN found in the well sample collected by the owner, which show that the groundwater has been effected, and might explain the apparent lack of electric neutrality. Samples MV1294-33, and MV1294-34 were collected from production wells with automatic chlorinators, thus compromising the electrical neutrality of the water. Sample MV1294-46 was collected from a drinking water system. Work on this well had just been completed prior to sampling, thus the neutrality of the water was compromised. Sample MV1294-64 collected from a monitor well had an extremely high turbidity level (340 NTU's) which may have interfered with analytical procedures, and known contamination; which would suggest that the groundwater could be electrically unequilibrated. Six samples (MV1294-32, MV1294-35, MV1294-36, MV1294-37, MV1294-45, and MV1294-68) have a combination of elevated TDS concentrations, which is a strong indicator that this groundwater has been affected possibly by man, and is not

electrically neutral.

5.4 Stiff Diagrams

Stiff diagrams were prepared to graphically display the water quality data. These diagrams show percent milliequivalents of the major ions. The ratios of these ions is represented, and not the actual concentrations. Therefore, when a shape is similar it does not necessarily show equal concentrations, but equal ratios of the ions. This presents a qualitative look at the data, rather than quantitative. A single scale plot was utilized which plots all ions in the same units. It should be noted that potassium was not analyzed, and will effect the diagram for that ion. However, potassium is typically a minimal constituent.

The stiff diagrams for this report were generated using the program HC-GRAM Version 3.02.0. The carbonate and bicarbonate data was calculated from the cation-anion balance equations, and entered into the program. All other cation and anion data are from the laboratory analytical results. Both groundwater and surface water data have been plotted. The June 1994 data is represented on Figure 10, and the December 1994 data is depicted on Figure 11.

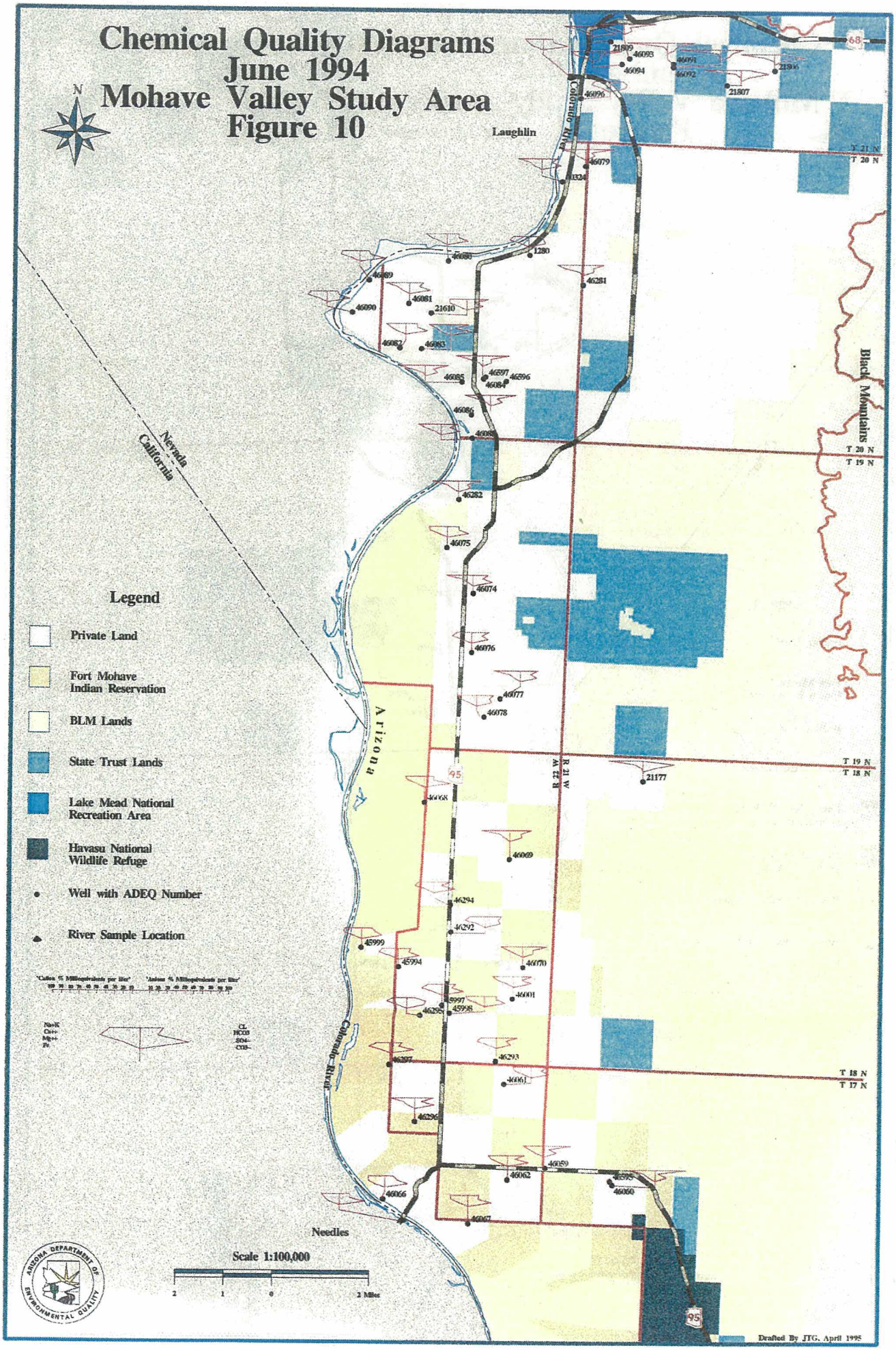
A simple interpretation of the stiff diagrams was made by visual comparison of diagram geometries. Groundwater recharge is predominantly from the Colorado River, and the sample collected at the Bullhead-Laughlin bridge would be the most representative of water that has not been impacted by the study area. The two stiff diagrams for the two river samples collected, are nearly identical, from this it is apparent that there is minimal impact on the river water quality from the study area. Stiff diagram geometries that are different from these river samples demonstrate ground water systems that vary from the surface water system, and has been influenced by either natural or anthropogenic influences.

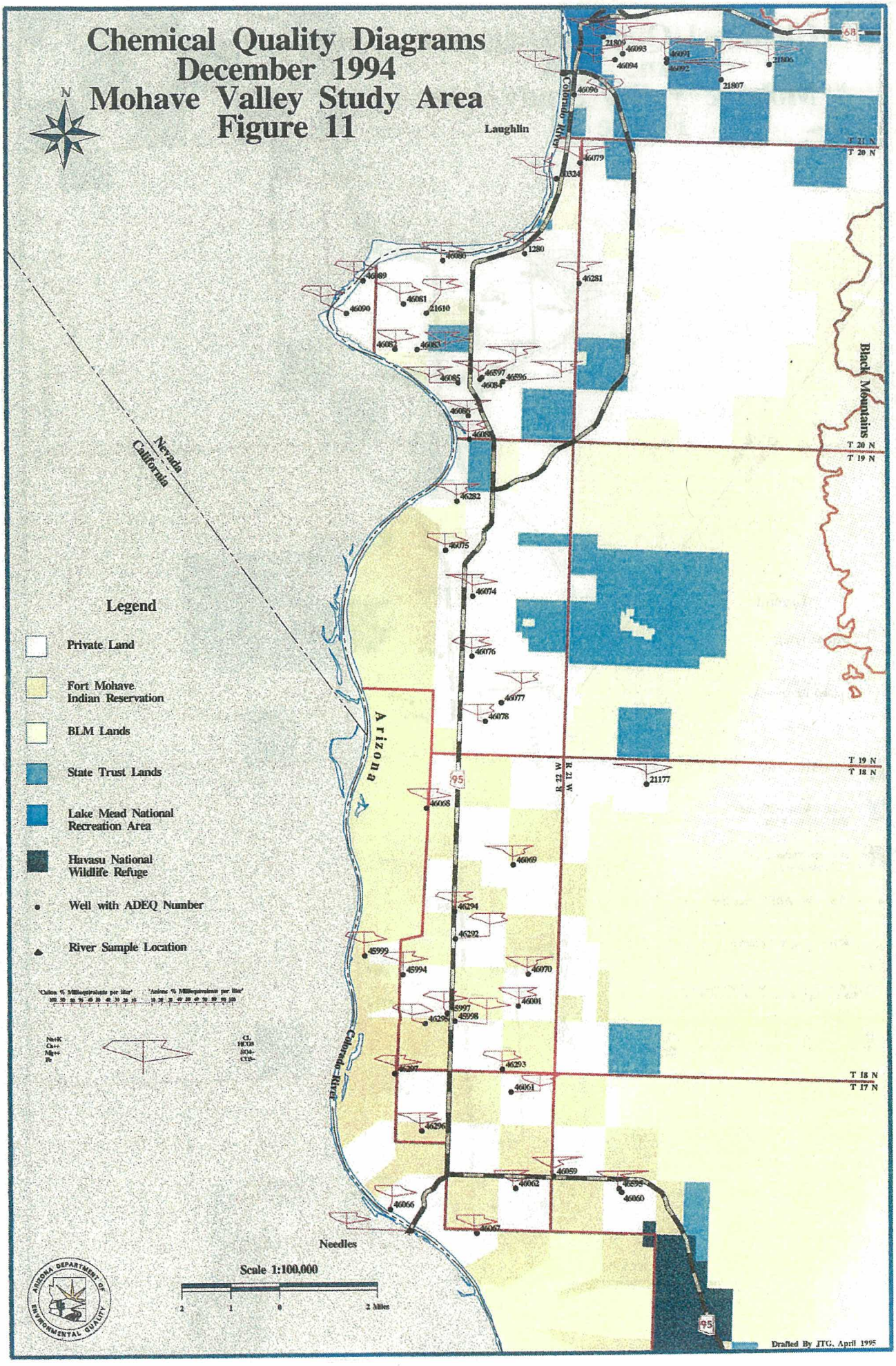
A comparison of the river sample diagrams with stiff diagrams from other groundwater samples was done. It can be seen that surface water diagrams compare very closely with samples from wells 46066, 46067, and 46080, which demonstrates that groundwater close or adjacent to the river in this area is predominantly recharged from the surface water. There are also several others that have quite similar shapes, but can be distinguished as having water quality slightly different from the base river samples. These wells represent groundwater predominantly derived from the Colorado River.

The next step taken was to look at the stiff geometries of known contaminated water samples. Wells 00324, 21610, 46085, and 46086 all have high nitrate, chloride, and TDS results. The shapes of these diagrams is quite distinctive from those of the river samples. Similar stiff diagram geometries can be seen in several other wells. What this may demonstrate is that several wells show signs of septic effluent, though not as severely impacted.

Other notable stiff geometries are those on the northern end of the study area, wells 21806 and 21807, and well 21177 in the middle of the study area to the east. These wells are all on the mesa away from the river and have high sodium and bicarbonate. This may demonstrate that the groundwater is naturally salty and these salts are concentrated further away from the river; or may indicate impacts from waste water disposal from septic systems. Especially when the nitrate and TDS values in these wells are considered.

Chemical Quality Diagrams
June 1994
Mohave Valley Study Area
Figure 10




Chemical Quality Diagrams
December 1994
Mohave Valley Study Area
Figure 11
N
Laughlin
Colorado River
Nevada
California
Arizona
Black Mountains
Needles
Colorado River
T 21 N
T 20 N
T 19 N
T 18 N
T 17 N
R 22 W
W 21 N
95
68
Legend
Private Land
Fort Mohave Indian Reservation
BLM Lands
State Trust Lands
Lake Mead National Recreation Area
Havasu National Wildlife Refuge
Well with ADEQ Number
River Sample Location
Scale 1:100,000
2 1 0 2 Miles
ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
Drafted By JTG, April 1995

Next the study considered the comparison of stiff diagrams for water samples collected at the same location, but in different seasons to see if there are seasonal variations. Differences can be visibly seen at wells 21809, 46076, 46281, and 46293. The geometry changes may represent seasonal changes on a local scale or changes through time, however, no uniform change (pattern) was observed.

Well 21809, shows a large increase in actual chloride from the June sample to the December sample, and a slight decrease in percentage of sulfate and bicarbonate was observed. There is no apparent reason for the increase in chloride.

Samples from well 46076 show a slight increase in chloride and a similar decrease in percent bicarbonate from the June to December sampling.Samples from well 46281 show an increase in calcium, chloride and sulfate from June to December.

At well 46293 there was an evident decrease in chloride from the June sample to the December sample. This was one of the few wells that showed a decrease in chloride between sampling events.

5.5 Limitation of Data

Collection and subsequent interpretation of data are the basis of any assessments made during a water quality study. Awareness of the limitation of the data is essential in formulating recommendations based on the study.

In an alluvial aquifer, the vertical distribution of nitrate is not uniform, since little vertical mixing occurs naturally. In theory, the upper most portion of the aquifer should exhibit the highest concentration levels of contaminants.

When data on nitrate levels in groundwater is obtained from production wells, certain information is lost. Since production wells are screened over a large vertical extent of an aquifer the ability to determine the exact depth of nitrate or other types of contamination is difficult. Also, because a cone of depression forms, the water from various levels intermix, and interrupts the hydrologic gradient, hence the water quality data from a production well only represents the condition at a localized site in the aquifer at a given time.

However, general observations can be made with regard to the occurrence of nitrate and other contaminants in groundwater, and by reviewing historical analyses, water quality trends can be identified.

SECTION 6 CONCLUSIONS

The geology of the area has a strong influence on the hydrology and on the water quality of the region. The contact between the young unconsolidated alluviums and the older alluviums affects the amount of infiltration of river water. This affects the groundwater temperature and chemistry. For this reason the water temperature model created using temperature data for water samples collected in

June 1994 mimics the geologic contacts, and to a lesser degree the elevation contours.

Nitrate/Nitrite (as N) laboratory results are displayed in concentration ranges for June and December 1994 sampling events in Figures 5 and 6 respectively. Areas of note are the Riviera area, Old Bullhead City, north Mesa area, and section B(20,22)26. In these areas there is an obvious and direct correlation between elevated nitrate values in groundwater and high density population areas using on-site septic systems.

Chlorides, sulfates and TDS constituents are all representative of septic tank disposal. The numerous wells that have been noted during both sampling events with elevated chlorides, sulfates, and TDS seem to suggest impacts from waste disposal that is prevalent throughout the northern two-thirds of the study area.

Arsenic contamination whether natural or caused by human influences, is an extremely important health issue because it is harmful when consumed by humans. The arsenic in the area is most probably natural, but this study did not provide sufficient data to determine this or the extent and magnitude of levels in groundwater.

SECTION 7 RECOMMENDATIONS

In the December 1970 report "Colorado River Study in Bullhead City Area" by the Arizona State Department of Health, there was a recommendation to form a sanitary district, and get the region on a common sewer treatment plant. Again in Cynthia Darr's report "Groundwater Quality in the Bullhead City area, Mohave County, Arizona", prepared by the Arizona Department of Environmental Quality, November 1989, Darr indicated in her conclusions the groundwater quality has been affected by discharging septic systems in the old Bullhead City area and other parts of the Riviera area. This is the third report in the series, and the conclusions mimic those of the previous reports.

The problems in Bullhead City were noted 25 years ago, and have not improved with time and increased population. Parts of the Bullhead City area are currently being sewered, with the Old Bullhead City area scheduled to come on line in June 1995. The Department should discuss the findings of this report with local officials and implement a plan to continue the local efforts to provide sewer collection systems and wastewater treatment.

The north Mesa area is growing in population very rapidly. Nitrate levels of 5.07 mg/L to 8.12 mg/L should not be ignored. The levels of nitrate are increasing with population growth. In Engineering Bulletin No. 12, 1989, it states that for nitrate contamination "from 5.1 up to 7.0 mg/L the maximum disposal density may be 400 gallons per acre per day; and in areas where ambient groundwater nitrate concentration exceeds 7.0 mg/L the statewide general permit is not valid. No new septic tank installations be allowed unless justified in an individual permit application or in other administrative actions from the Department of Environmental Quality." Despite great depth to groundwater in this area, the department may want to look further into the future development of the north Mesa area.

In addition, with the recent completion of the Bullhead City Parkway, many new subdivisions, a golf

course, and an industrial park are proposed for the east Mesa area. This is the first time that the Bullhead City Planning and Zoning would have the opportunity to plan for the future development for a portion of the city. With the sandy soils throughout the area, the development of sanitary districts at the onset of a development is imperative. Water quality should be continued to be monitored to observe impacts of further development on the region. The department should continue annual water quality sampling of the study area, and include wells from these new areas, as they are developed.

The need for strong wastewater disposal control is justified by the high nitrate values in wells sampled throughout the study area. It was observed that the nitrate contamination is concentrated in areas where there is more road development, and thus more densely populated areas. This is noted in every groundwater sample with elevated nitrate levels, and low levels of nitrate was found along the Colorado River, where the contaminants are washed out, or in the less populated agricultural areas. Also, it is clear that nitrate in groundwater in the study area is not due to fertilizers from agricultural applications.

Arsenic in the study area is an important health risk. Groundwater sampling should be extended in the area of known arsenic contamination to determine the extent of private wells that may be affected. Many private citizens may be unaware of the presence of this substance in their primary water source. Two of these wells are public water systems, with the rest of the wells being predominantly private with up to six homes utilizing each individual well. Once the extent and magnitude of the problem is defined, the citizens can then be completely advised on procedures to deal with arsenic in their drinking water. The department should identify well owners in the area of known contamination and in cooperation with the Arizona Department of Health Services (ADHS), should sample those wells to better define the problem.

ACKNOWLEDGMENTS

We want to acknowledge the Mohave County Health and Social Services Environmental Health Division, the Fort Mohave Indian Tribe, and the Bureau of Land Management Surface Water Monitoring for their time, assistance, work, and cooperation in this study. Also, the Hydrologic Analysis Unit of ADEQ who have all worked and contributed to this project.

Appendix A
June 1994 Sample Results

MCL		0.05	1.00	0.010		0.05			0.05			0.002	0.01	0.05		
SMCL							1.0	0.3			0.05				5.0	
	Sample #	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Metals Iron	Lead	Magnesium	Manganese	Mercury	Selenium	Silver	Sodium	Zinc	Aluminum
	MV694-01	<0.005	<0.05	<0.0005	75	<0.005	<0.05	<0.05	<0.005	26	<0.05	<0.0002	<0.005	<0.005	210	<0.05	
	MV694-02	<0.005	<0.05	<0.0005	14	0.008	<0.05	<0.05	<0.005	1.7	<0.05	<0.0002	<0.005	<0.005	63	<0.05	
Field Blank	MV694-03	<0.005	<0.05	<0.0005	<0.05	<0.005	<0.05	0.05	<0.005	<0.05	<0.05	<0.0002	<0.005	<0.005	<1.0	<0.05	
	MV694-04	<0.005	<0.05	<0.0005	77	<0.005	<0.05	<0.05	<0.005	29	0.06	<0.0002	0.006	<0.005	87	<0.05	
	MV694-05	<0.005	0.06	<0.0005	190	<0.005	<0.05	<0.05	<0.005	62	<0.05	<0.0002	<0.005	<0.005	220	<0.05	
	MV694-06	<0.005	0.11	0.001	91	<0.005	<0.05	0.97	0.009	25	0.85	<0.0002	<0.005	<0.005	82	<0.05	
Field Blank	MV694-07	<0.005	<0.05	<0.0005	<0.05	<0.005	<0.05	0.05	<0.005	<0.05	<0.05	<0.0002	<0.005	<0.005	<1.0	<0.05	
	MV694-08	<0.005	0.07	<0.0005	140	<0.005	<0.05	1.4	<0.005	52	0.34	<0.0002	<0.005	<0.005	360	<0.05	
	MV694-09	<0.005	<0.05	<0.0005	66	<0.005	<0.05	0.13	<0.005	5.0	<0.05	<0.0002	<0.005	<0.005	110	<0.05	
	MV694-10	<0.005	<0.05	<0.0005	98	<0.005	<0.05	1.1	<0.005	36	0.46	<0.0002	<0.005	<0.005	150	<0.05	
	MV694-11	0.009	0.11	<0.0005	180	<0.005	<0.05	<0.05	<0.005	73	<0.05	<0.0002	<0.005	<0.005	430	<0.05	
	MV694-12	<0.005	0.11	<0.0005	220	<0.005	<0.05	0.62	<0.005	83	0.74	<0.0002	<0.005	<0.005	360	<0.05	
	MV694-13	0.059	<0.05	<0.0005	79	0.006	<0.05	0.29	<0.005	12	<0.05	0.0003	<0.005	<0.005	180	<0.05	
	MV694-14[2]	<0.005	<0.05	<0.0005	90	0.008	<0.05	0.32	<0.005	32	<0.05	<0.0002	<0.005	<0.005	200	<0.05	
	MV694-15[2]	<0.005	<0.05	<0.0005	92	0.006	<0.05	0.35	<0.005	32	<0.05	<0.0002	<0.005	<0.005	200	<0.05	
	MV694-16	<0.005	<0.05	0.0008	310	<0.005	<0.05	0.64	0.006	130	<0.05	<0.0002	0.005	<0.005	550	<0.05	
Needles Bridge	MV694-17[3]	<0.005	0.15	<0.0005	78	<0.005	<0.05	<0.05	<0.005	34	<0.05	<0.0002	<0.005	<0.005	110	<0.05	
Laughlin Bridge	MV694-18[3]	<0.005	0.14	<0.0005	77	<0.005	<0.05	<0.05	<0.005	33	<0.05	<0.0002	<0.005	<0.005	110	<0.05	
	MV694-19	0.011	0.09	<0.0005	130	<0.005	<0.05	0.39	<0.005	36	0.58	<0.0002	<0.005	<0.005	120	<0.05	
	MV694-20	<0.005	0.15	<0.0005	250	<0.005	<0.05	0.71	<0.005	67	1.2	<0.0002	<0.005	<0.005	230	<0.05	
	MV694-21[2]	<0.005	0.09	<0.0005	180	<0.005	<0.05	0.83	<0.005	50	1.0	<0.0002	<0.005	<0.005	240	<0.05	
	MV694-22[2]	<0.005	0.09	<0.0005	170	<0.005	<0.05	0.80	<0.005	49	1.0	<0.0002	<0.005	<0.005	240	<0.05	
Field Blank	MV694-23	<0.005	<0.05	<0.0005	<0.05	<0.005	<0.05	<0.05	<0.005	<0.05	<0.05	<0.0002	<0.005	<0.005	<1.0	<0.05	
	MV694-24	0.007	0.10	<0.0005	160	<0.005	<0.05	0.58	<0.005	49	0.74	<0.0002	<0.005	<0.005	200	<0.05	
	MV694-25	ND	ND	ND	93.3	ND	ND	ND	ND	27.6	0.06	ND	ND	ND	114	ND	ND
Field Blank	MV694-26	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

All Sample Units are mg/L Unless Otherwise Noted
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
June 1994 Sample Results

MCL		0.05	1.00	0.010		0.05			0.05			0.002	0.01	0.05			
SMCL							1.0	0.3			0.05					5.0	
								Metals									
	Sample #	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Selenium	Silver	Sodium	Zinc	Aluminum
	MV694-27	ND	ND	ND	103	ND	0.021	ND	ND	24.1	ND	ND	ND	ND	171	ND	ND
	MV694-28	ND	0.13	ND	91.5	ND	0.027	0.26	0.006	23.1	0.62	ND	ND	ND	93.6	ND	ND
	MV694-29	0.115	ND	ND	11.7	0.029	ND	ND	ND	1.1	ND	ND	ND	ND	206	ND	ND
	MV694-30	0.037	ND	ND	18.4	0.023	ND	ND	ND	1.6	ND	ND	ND	ND	216	ND	ND
	MV694-31	0.014	ND	ND	116	0.025	0.370	7.75	0.041	21.9	0.09	ND	ND	ND	161	0.39	ND
	MV694-32	ND	ND	ND	126	ND	0.024	ND	ND	20.9	ND	ND	ND	ND	220	ND	ND
	MV694-33	ND	ND	ND	86.7	ND	ND	1.01	ND	16.4	ND	ND	ND	ND	247	0.07	ND
	MV694-34[2]	0.017	ND	ND	13.1	0.015	ND	ND	ND	ND	ND	ND	ND	ND	96.4	ND	ND
	MV694-35[2]	0.019	ND	ND	12.3	0.016	ND	ND	ND	ND	ND	ND	ND	ND	95.9	ND	ND
	MV694-36	0.012	ND	ND	20.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	77.9	ND	ND
	MV694-37	ND	ND	ND	873	ND	ND	5.58	ND	295	2.57	ND	ND	ND	2074	0.09	ND
	MV694-38	ND	ND	ND	176	ND	ND	2.01	ND	55.6	0.93	ND	ND	ND	210	ND	ND
	MV694-39	ND	ND	ND	210	ND	ND	1.16	ND	56.7	0.73	ND	ND	ND	320	ND	ND
	MV694-40	0.014	ND	ND	99.8	ND	ND	0.19	ND	29.1	0.33	ND	ND	ND	169	ND	ND
Field Blank	MV694-41	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-42	ND	ND	ND	94.5	ND	ND	ND	ND	23.4	0.57	ND	ND	ND	99.4	ND	ND
	MV694-43[2]	0.018	ND	ND	108	ND	ND	ND	ND	18.8	ND	ND	ND	ND	231	ND	ND
	MV694-44[2]	0.018	ND	ND	108	ND	ND	ND	ND	18.8	ND	ND	ND	ND	228	ND	ND
	MV694-45	ND	ND	ND	365	ND	ND	1.51	ND	110	1.42	ND	ND	ND	495	ND	ND
	MV694-46	ND	ND	ND	82.7	ND	ND	0.11	ND	29.2	0.32	ND	ND	ND	276	ND	ND
	MV694-47	ND	ND	ND	104	ND	ND	ND	0.006	33.8	ND	ND	ND	ND	142	ND	ND
	MV694-48	ND	ND	ND	80.6	ND	0.016	ND	ND	24.2	ND	ND	ND	ND	221	ND	ND
	MV694-49	ND	ND	ND	113	ND	ND	ND	ND	31.3	0.44	ND	ND	ND	173	ND	ND
Field Blank	MV694-50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-51	ND	ND	ND	183	ND	ND	ND	ND	74.9	ND	ND	ND	ND	412	ND	ND
Field Blank	MV694-52	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-53	ND	0.43	ND	171	0.012	0.012	18.5	0.013	45.9	0.55	ND	ND	ND	158	0.11	13.8

All Sample Units are mg/L Unless Otherwise Noted
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
June 1994 Sample Results

MCL		0.05	1.00	0.010		0.05			0.05			0.002	0.01	0.05			
SMCL							1.0	0.3			0.05					5.0	
								Metals									
	Sample #	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Selenium	Silver	Sodium	Zinc	Aluminum
	MV694-54	0.011	ND	ND	279	ND	ND	0.72	ND	72.6	1.11	ND	ND	ND	232	ND	ND
	MV694-55	ND	ND	ND	184	ND	ND	0.93	ND	51.5	0.77	ND	ND	ND	234	ND	ND
	MV694-56	ND	ND	ND	122	ND	ND	0.27	ND	29.1	0.49	ND	ND	ND	107	ND	ND
	MV694-57	ND	ND	ND	179	ND	0.010	0.64	ND	45.5	0.92	ND	ND	ND	172	ND	ND
	MV694-58	ND	ND	ND	92.8	ND	0.011	0.37	ND	28.4	0.50	ND	ND	ND	99.2	ND	ND
	MV694-59	ND	ND	ND	164	ND	ND	ND	ND	50.1	ND	ND	ND	ND	139	ND	ND
Field Blank	MV694-60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-61	0.017	ND	ND	105	ND	ND	0.23	ND	10.8	ND	0.0015	ND	ND	247	ND	ND
	MV694-62	ND	ND	ND	165	ND	ND	0.76	ND	47.0	1.19	ND	ND	ND	125	ND	ND
	MV694-63	0.013	ND	ND	301	ND	0.020	ND	ND	76.1	0.33	ND	ND	ND	222	ND	ND
Field Blank	MV694-64	<0.005	<0.05	<0.0005	<0.05	<0.005	<0.05	<0.05	<0.005	<0.05	<0.05	<0.0002	<0.005	<0.005	<1.0	<0.05	
	MV694-65[2]	<0.005	0.06	<0.0005	250	0.008	<0.05	3.1	<0.005	96	0.90	<0.0002	<0.005	<0.005	610	<0.05	
	MV694-66[2]	ND	ND	ND	254	ND	ND	2.67	ND	90.4	0.83	ND	ND	ND	560	ND	ND

All Sample Units are mg/L Unless Otherwise Noted
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
June 1994 Sample Results

MCL				4.0		10.0	1.0	10.0						
SMCL			250	2.0					250	500				6.5-8.5
							Non-Metals							
	Sample #	Alkalinity Phenol	Alkalinity mg/L as $CaCO_3$	Chloride	Fluoride	Hardness	Nitrate/ Nitrite as N	Nitrite as N (NO2-N)	Nitrate as N (NO3-N)	Sulfate	TDS	Specific Conductance	Turbidity (NTU)	pH (SU)
	MV694-01		180	230	0.34	290	3.10			290	960	1,450	1.1	7.9
	MV694-02		110	<5.0	0.51	42	5.25			40	240	364	0.11	8.3
Field Blank	MV694-03		6.0	<5.0	<0.10	<0.50	<0.100			<5.0	<5.0	1.0	0.02	7.5
	MV694-04		150	72	0.29	310	0.240			270	630	838	0.59	8.0
	MV694-05		190	410	0.18	730	10.5			420	1,500	2,100	<0.02	7.8
	MV694-06		180	110	0.44	330	0.443			190	650	903	6.8	7.6
Field Blank	MV694-07		5.0	<5.0	<0.10	<0.50	0.367			<5.0	<5.0	1.4	0.20	8.3
	MV694-08		270	540	0.48	560	0.519			380	1,800	2,340	21	7.6
	MV694-09		110	150	1.0	180	1.33			110	560	813	0.93	7.9
	MV694-10		200	140	0.26	390	<0.100			370	950	1,203	7.7	8.0
	MV694-11		230	810	0.23	750	7.20			350	1,900	2,860	0.47	7.7
	MV694-12		180	760	0.14	890	<0.100			500	2,100	3,110	0.18	7.9
	MV694-13		120	280	1.6	250	7.50			120	840	1,240	2.5	7.9
	MV694-14[2]		180	180	0.18	360	3.54			370	1,100	1,368	3.7	7.9
	MV694-15[2]		180	180	0.18	360	3.42			390	1,100	1,375	1.1	7.9
	MV694-16		240	690	0.17	1,300	9.63			1,100	3,200	3,565	0.72	7.7
Needles Bridge	MV694-17[3]		130	94	0.29	330	0.519			310	680	1,018	0.84	8.2
Laughlin Bridge	MV694-18[3]		140	89	0.31	330	0.304			320	720	1,079	0.70	8.2
	MV694-19		210	320	0.21	470	<0.100			300	930	1,313	0.63	7.9
	MV694-20		240	380	0.16	900	<0.100			680	1,800	2,230	0.50	7.9
	MV694-21[2]		240	200	0.20	660	<0.100			720	1,600	1,861	0.15	7.7
	MV694-22[2]		240	180	0.21	630	0.190			720	1,600	1,856	0.12	7.9
Field Blank	MV694-23		5.0	19	<0.10	<0.50	<0.100			<5.0	<5.0	2.3	0.45	7.1
	MV694-24		220	290	0.21	600	<0.100			400	1,300	1,721	0.22	8.0
	MV694-25	ND	149	107	0.45	364	ND	ND	ND	265	788		0.02	7.88
Field Blank	MV694-26	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		0.08	6.04

All Sample Units are mg/L Unless Otherwise Noted
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
June 1994 Sample Results

MCL				4.0		10.0	1.0	10.0						
SMCL				250	2.0					250	500			6.5-8.5
							Non-Metals							
	Sample #	Alkalinity Phenol	Alkalinity mg/L as $CaCO_3$	Chloride	Fluoride	Hardness	Nitrate/ Nitrite as N	Nitrite as N (NO2-N)	Nitrate as N (NO3-N)	Sulfate	TDS	Specific Conductance	Turbidity (NTU)	pH (SU)
	MV694-27	ND	140	192	0.78	364	0.69	ND	0.69	296	975		0.55	7.74
	MV694-28	ND	140	82.2	0.31	335	ND	ND	ND	247	706		1.55	8.00
	MV694-29	3.5	125	161	5.10	35	8.12	ND	8.12	87.1	656		0.02	8.51
	MV694-30	ND	112	217	3.48	55	7.12	ND	7.12	74.4	706		0.25	8.25
	MV694-31	ND	114	342	0.45	405	0.45	ND	0.45	131	1030		53	7.56
	MV694-32	ND	111	421	0.43	398	3.21	ND	3.21	135	1200		ND	7.67
	MV694-33	ND	81.8	38.2	1.71	285	4.79	ND	4.79	133	1030		9.0	7.72
	MV694-34[2]	ND	128	28.5	3.81	32	5.08	ND	5.08	35.6	361		ND	8.07
	MV694-35[2]	ND	126	28.5	3.56	32.0	5.07	ND	5.07	36.0	348		0.02	8.08
	MV694-36	ND	127	17.3	3.40	50	5.34	ND	5.34	28.6	320		0.01	7.85
	MV694-37	ND	483	4080	0.22	3290	ND	ND	ND	2060	9900		65	7.27
	MV694-38	ND	257	199	0.37	681	ND	ND	ND	587	1520		22	7.60
	MV694-39	ND	270	423	0.22	797	ND	ND	ND	549	1960		8.5	7.69
	MV694-40	ND	162	285	0.22	379	ND	ND	ND	159	942		0.40	7.73
Field Blank	MV694-41	ND	2.8	ND	ND	ND	ND	ND	ND	ND	ND		ND	5.91
	MV694-42	ND	144	84.1	0.25	337	ND	ND	ND	302	744		0.10	8.01
	MV694-43[2]	ND	124	359	1.97	357	0.95	ND	0.95	223	1160		0.04	7.52
	MV694-44[2]	ND	123	362	1.83	355	0.96	ND	0.96	201	1110		0.05	7.27
	MV694-45	ND	362	624	ND	1390	ND	ND	ND	1050	3310		16.4	7.46
	MV694-46	ND	235	324	0.45	394	ND	ND	ND	242	1200		4.9	7.89
	MV694-47	ND	181	172	0.28	385	7.48	ND	7.48	214	915		0.05	7.74
	MV694-48	ND	161	179	0.44	292	5.53	ND	5.53	309	1020		0.73	7.96
	MV694-49	ND	192	140	0.25	400	1.42	ND	1.42	328	1030		0.26	8.02
Field Blank	MV694-50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		0.12	5.40
	MV694-51	ND	349	387	0.30	761	14.4	ND	14.4	649	2140		0.10	7.83
Field Blank	MV694-52	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		0.02	5.40

All Sample Units are mg/L Unless Otherwise Noted
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
June 1994 Sample Results

MCL					4.0		10.0	1.0	10.0					
SMCL				250	2.0					250	500			6.5-8.5
							Non-Metals							
	Sample #	Alkalinity Phenol	Alkalinity mg/L as $CaCO_3$	Chloride	Fluoride	Hardness	Nitrate/ Nitrite as N	Nitrite as N (NO2-N)	Nitrate as N (NO3-N)	Sulfate	TDS	Specific Conductance	Turbidity (NTU)	pH (SU)
	MV694-53	ND	325	165	0.37	628	ND	ND	ND	289	1110		348	7.47
	MV694-54	ND	309	320	0.23	1070	ND	ND	ND	702	2110		6.2	7.77
	MV694-55	ND	291	216	0.27	669	ND	ND	ND	506	1600		5.7	8.09
	MV694-56	ND	192	171	0.23	422	ND	ND	ND	217	909		1.20	7.98
	MV694-57	ND	222	201	0.22	622	ND	ND	ND	447	1390		4.7	8.03
	MV694-58	ND	163	89.3	0.36	341	ND	ND	ND	237	757		1.72	8.02
	MV694-59	ND	212	255	0.23	617	1.78	ND	1.78	322	1240		0.08	7.81
Field Blank	MV694-60	ND	2.2	ND	ND	ND	ND	ND	ND	ND	ND		0.02	5.64
	MV694-61	ND	153	313	2.84	301	7.19	ND	7.19	229	1190		0.41	7.96
	MV694-62	ND	355	107	0.28	549	ND	ND	ND	307	1090		2.5	8.22
	MV694-63	ND	282	275	ND	1090	ND	ND	ND	762	2090		0.38	7.85
Field Blank	MV694-64		12	<5.0	<0.10	<0.50	<0.100			<5.0	<5.0		0.12	6.1
	MV694-65[2]		330	680	0.47	1000	0.798			940	2900		31	7.2
	MV694-66[2]	ND	315	671	0.60	1050	0.58	ND	0.58	879	3030		21.5	7.79

All Sample Units are mg/L Unless Otherwise Noted
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
June 1994 Sample Results

MCL		5.0	100	600		75	700	1000			
SMCL											
					VOC's			Xylene (Total) MCL = 10000			
	Sample #	Benzene	Chlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Ethylbenzene	Toluene	m,p-Xylene	o-Xylene	Surrogate Recovery (%) 1-Chloro-2-fluorobenzene
	MV694-01[1]										
	MV694-02[1]										
Field Blank	MV694-03[1]										
	MV694-04[1]										
	MV694-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	100
	MV694-06[1]										
	MV694-07[1]										
	MV694-08[1]										
	MV694-09[1]										
	MV694-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	99
	MV694-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	98
	MV694-12[1]										
	MV694-13[1]										
	MV694-14[2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	89
	MV694-15[22]	ND	ND	ND	ND	ND	ND	ND	ND	ND	99
	MV694-16	ND	ND	ND	ND	ND	ND	ND	ND	ND	99
Needles Bridge	MV694-17[31]										
Laughlin Bridge	MV694-18[31]										
	MV694-19[1]										
	MV694-20	ND	ND	ND	ND	ND	ND	ND	ND	ND	88
	MV694-21[2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	86
	MV694-22[2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	88
Field Blank	MV694-23	ND	ND	ND	ND	ND	ND	ND	ND	ND	86
	MV694-24[1]										
	MV694-25[1]										
Field Blank	MV694-26[1]										

All Sample Units are ug/L Unless Otherwise Noted
[1] Not Sampled for VOC's
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
June 1994 Sample Results

MCL		5.0	100	600		75	700	1000		
SMCL										

		VOC's									Xylene (Total) MCL = 10,000		
	Sample #	Benzene	Chlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Ethylbenzene	Toluene	m,p-Xylene	o-Xylene	Surrogate Recovery (%) 1-Chloro-2-fluorobenzene		
	MV694-27[1]												
	MV694-28[1]												
	MV694-29[1]												
	MV694-30[1]												
	MV694-31[1]												
	MV694-32[1]												
	MV694-33[1]												
	MV694-34[1,2]												
	MV694-35[1,2]												
	MV694-36[1]												
	MV694-37[1]												
	MV694-38[1]												
	MV694-39[1]												
	MV694-40[1]												
Field Blank	MV694-41[1]												
	MV694-42[1]												
	MV694-43[1,2]												
	MV694-44[1,2]												
	MV694-45[1]												
	MV694-46[1]												
	MV694-47[1]												
	MV694-48[1]												
	MV694-49[1]												
Field Blank	MV694-50[1]												

All Sample Units are ug/L Unless Otherwise Noted
[1] Not Sampled For VOC's
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
June 1994 Sample Results

MCL		5.0	100	600		75	700	1000			
SMCL											
					VOC's				Xylene (Total) MCL = 10,000		
	Sample #	Benzene	Chlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Ethylbenzene	Toluene	m,p-Xylene	o-Xylene	Surrogate Recovery (%) 1-Chloro-2-fluorobenzene
	MV694-51	ND	ND	ND	ND	ND	ND	ND	ND	ND	94
Field Blank	MV694-52	ND	ND	ND	ND	ND	ND	ND	ND	ND	90
	MV694-53	ND	ND	ND	ND	ND	ND	ND	ND	ND	98
	MV694-54[1]										
	MV694-55[1]										
	MV694-56[1]										
	MV694-57[1]										
	MV694-58[1]										
	MV694-59[1]										
Field Blank	MV694-60[1]										
	MV694-61[1]										
	MV694-62[1]										
	MV694-63[1]										
Field Blank	MV694-64[1]										
	MV694-65[1]										
	MV694-65[12]										

All Sample Units are ug/L Unless Otherwise Noted
[1] Not Sampled For VOC's
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
June 1994 Sample Results

		Pesticides/Herbicides										
	Sample #	2,4-D	Methomyl	Chlordimeform	Trifluralin	Monocrotophos	Metribuzin	Methyl Parathion	Malathion	Chloropyrifos	Cypermethrin	Phthalates
	MV694-01[4]											
	MV694-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Blank	MV694-03[4]											
	MV694-04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-05[4]											
Field Blank	MV694-06[4]											
	MV694-07[4]											
	MV694-08[4]											
	MV694-09[4]											
	MV694-10[4]											
	MV694-11[4]											
	MV694-12*											
	MV694-13[4]											
	MV694-14[42]											
	MV694-15[42]											
	MV694-16[4]											
Needles Bridge	MV694-17[43]											
Laughlin Bridge	MV694-18[43]											
	MV694-19*											
	MV694-20*											
	MV694-21*2											
	MV694-22*2											
Field Blank	MV694-23*											
	MV694-24*											
	MV694-25[4]											
	MV694-27[4]											
	MV694-28[4]											
	MV694-29[4]											
	MV694-30[4]											

All Sample Units are ug/l Unless Otherwise Noted
* Did not meet QA Standards
[3] Surface Water Sample
[4] Not Sampled For Pest/Herb
[2] Duplicate Sample
ND Not Detected

Appendix A
June 1994 Sample Results

		Pesticides/Herbicides										
	Sample #	2,4-D	Methomyl	Chlordimeform	Trifluralin	Monocrotophos	Metribuzin	Methyl Parathion	Malathion	Chloropyrifos	Cypermethrin	Phthalates
	MV694-31[4]											
	MV694-32[4]											
	MV694-33[4]											
	MV694-34[24]											
	MV694-35[24]											
	MV694-36[4]											
	MV694-37	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-38	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	TRACE
	MV694-39	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Blank	MV694-41[4]											
	MV694-42[4]											
	MV694-43[2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-44[2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-45	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-46	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-47[4]											
	MV694-48[4]											
	MV694-49[4]											
Field Blank	MV694-50[4]											
	MV694-51[4]											
Field Blank	MV694-52[4]											
	MV694-53[4]											
	MV694-54	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-55	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-56	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-58	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-59[4]											

All Sample Units are ug/l Unless Otherwise Noted
* Did not meet QA Standards
[3] Surface Water Sample
[4] Not Sampled for Pest/Herb
[2] Duplicate Sample
ND Not Detected

Appendix A
June 1994 Sample Results

		Pesticides/Herbicides										
	Sample #	2,4-D	Methomyl	Chlordimeform	Trifluralin	Monocrotophos	Metribuzin	Methyl Parathion	Malathion	Chloropyrifos	Cypermethrin	Phthalates
Field Blank	MV694-60[4]											
	MV694-61[4]											
	MV694-62	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV694-63	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Blank	MV694-64*											
	MV694-65*											
	MV694-66[2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

All Sample Units are ug/l Unless Otherwise Noted
* Did not meet QA Standards
[3] Surface Water Sample
[4] Not Sampled for Pest/Herb
[2] Duplicate Sample
ND Not Detected

Appendix A
June 1994 Sample Results

		Pesticides/Herbicides				
	Sample #	Butifos	Ethyl parathion	Fluazifop-butyl	Azinphos-methyl	Permethrin
	MV694-01[4]					
	MV694-02[4]					
Field Blank	MV694-03[4]					
	MV694-04[4]					
	MV694-05[4]					
	MV694-06[4]					
Field Blank	MV694-07[4]					
	MV694-08[4]					
	MV694-09[4]					
	MV694-10[4]					
	MV694-11[4]					
	MV694-12*					
	MV694-13[4]					
	MV694-14[24]					
	MV694-15[24]					
	MV694-16[4]					
Needles Bridge	MV694-17[34]					
Laughlin Bridge	MV694-18[34]					
	MV694-19*					
	MV694-20*					
	MV694-21[2*]					
	MV694-22[2*]					
Field Blank	MV694-23*					
	MV694-24*					
	MV694-25[4]					
	MV694-27[4]					
	MV694-28[4]					
	MV694-29[4]					
	MV694-30[4]					
	MV694-31[4]					

All Sample Units are ug/l Unless Otherwise Noted
* Did not meet QA Standards
[3] Surface Water Sample
[4] Not Sampled for Pest/Herb
[2] Duplicate Sample
ND Not Detected

Appendix A
June 1994 Sample Results

		Pesticides/Herbicides				
	Sample #	Butifos	Ethyl parathion	Fluazifop-butyl	Azinphos-methyl	Permethrin
	MV694-32[4]					
	MV694-33[4]					
	MV694-34[24]					
	MV694-35[24]					
	MV694-36[4]					
	MV694-37	ND	ND	ND	ND	ND
	MV694-38	ND	ND	ND	ND	ND
	MV694-39	ND	ND	ND	ND	ND
	MV694-40	ND	ND	ND	ND	ND
Field Blank	MV694-41	ND	ND	ND	ND	ND
	MV694-42[4]					
	MV694-43[4]	ND	ND	ND	ND	ND
	MV694-44[4]	ND	ND	ND	ND	ND
	MV694-45	ND	ND	ND	ND	ND
	MV694-46	ND	ND	ND	ND	ND
	MV694-47[4]					
	MV694-48[4]					
	MV694-49[4]					
Field Blank	MV694-50[4]					
	MV694-51[4]					
Field Blank	MV694-52[4]					
	MV694-53[4]					
	MV694-54	ND	ND	ND	ND	ND
	MV694-55	ND	ND	ND	ND	ND
	MV694-56	ND	ND	ND	ND	ND
	MV694-57	ND	ND	ND	ND	ND
	MV694-58	ND	ND	ND	ND	ND
	MV694-59[4]					
Field Blank	MV694-60	ND	ND	ND	ND	ND
	MV694-61[4]					

All Sample Units are ug/L Unless Otherwise Noted
* Did not meet QA Standards
[3] Surface Water Sample
[4] Not Sampled for Pest/Herb
[2] Duplicate Sample
ND Not Detected

Appendix A
June 1994 Sample Results

		Pesticides/Herbicides				
	Sample #	Butifos	Ethyl parathion	Fluazifop-butyl	Azinphos-methyl	Permethrin
	MV694-62	ND	ND	ND	ND	ND
	MV694-63	ND	ND	ND	ND	ND
Field Blank	MV694-64*					
	MV694-65*					
	MV694-66[2]	ND	ND	ND	ND	ND

All Sample Units are ug/L Unless Otherwise Noted
* Did not meet QA Standards
[3] Surface Water Sample
[4] Not Sampled for Pest/Herb
[2] Duplicate Sample
ND Not Detected

Appendix A
August 1994 Sample Results

MCL		0.05	1.00	0.010		0.05			0.05			0.002	0.01	0.05		
SMCL							1.0	0.3			0.05				5.0	
								Metals								
	Sample #	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Iron -	Lead	Magnesium	Manganese	Mercury	Selenium	Silver	Sodium	Zinc	Aluminum
	MV894-01	0.011	0.06	<0.0005	210	<0.005	<0.05	<0.05	<0.005	60	<0.05	<0.0002	<0.005	<0.005	240	<0.05	
Field Blank	MV894-02	<0.005	<0.05	<0.0005	<0.10	<0.005	<0.05	<0.05	<0.005	<0.20	<0.05	<0.0002	<0.005	<0.005	<1.0	<0.05	
	MV894-03	<0.010	0.06	<0.0005	120	0.017	<0.05	0.35	<0.005	26	0.85	0.0004	<0.005	<0.005	97	<0.05	
	MV894-04	<0.010	0.07	<0.0005	160	<0.005	<0.05	1.5	<0.005	44	0.35	<0.0002	<0.005	<0.005	360	<0.05	

MCL						4.0		10.0	1.0	10.0						
SMCL					250	2.0					250	500			6.5-8.5	
								Non-Metals								
	Sample #	Alkalinity Phenol	Alkalinity mg/L as $CaCO_3$	Chloride	Fluoride	Hardness	Nitrate/ Nitrite as N	Nitrite as N (NO2-N)	Nitrate as N (NO3-N)	Sulfate	TDS	Specific Conductance	Turbidity (NTU)	pH (SU)		
	MV894-01			390	0.18	770	10.7			430			0.04			
Field Blank	MV894-02			<5.0	<0.10	<1	<0.10			<5.0			0.09			
	MV894-03			140	0.44	410	<0.10			250			27			
	MV894-04			460	0.46	580	<0.10			390			14			

All Sample Units are ug/L Unless Otherwise Noted
[4] Not Sampled for Pest/Herb
[1] Not Sampled for VOC's

Appendix A
August 1994 Sample Results

MCL		5.0	100	600		75	700	1000				
SMCL												
						VOC's			Xylene (Total) MCL = 10000			
	Sample #	Benzene	Chlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Ethylbenzene	Toluene	m,p-Xylene	o-Xylene	Surrogate Recovery (%) 1-Chloro-2-fluorobenzene	
Field Blank	MV894-01[1]											
	MV894-02[1]											
	MV894-03[1]											
	MV894-04[1]											

						Pesticides/Herbicides					
	Sample #	2,4-D	Methomyl	Chlordimeform	Trifluralin	Monocrotophos	Metribuzin	Methyl Parathion	Malathion	Chloropyrifos	Cypermethrin	Phthalates
Field Blank	MV894-01[4]											
	MV894-02[4]											
	MV894-03[4]											
	MV894-04[4]											

					Pesticides/Herbicides	
	Sample #	Butifos	Ethyl parathion	Fluazifop-butyl	Azinphos-methyl	Permethrin
Field Blank	MV694-05[4]					
	MV894-02[4]					
	MV894-03[4]					
	MV894-04[4]					

All Sample Units are ug/L Unless Otherwise Noted
[4] Not Sampled for Pest/Herb
[1] Not Sampled for VOC's

Appendix A
December 1994 Sample Results

MCL		0.05	1.00	0.010		0.05			0.05			0.002	0.01	0.05		
SMCL							1.0	0.3			0.05				5.0	
								Metals								
	Sample #	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Selenium	Silver	Sodium	Zinc	Aluminum
	MV1294-01	0.109	<0.05	<0.0005	88	<0.005	<0.05	0.57	<0.005	13	<0.05	<0.0002	<0.005	<0.005	190	<0.05	
	MV1294-02	0.011	ND	ND	146	ND	0.010	ND	ND	38.3	ND	ND	ND	ND	172	ND	ND
Field Blank	MV1294-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV1294-04	ND	ND	ND	97.2	ND	ND	ND	ND	29.5	ND	ND	ND	ND	109	ND	ND
	MV1294-05	0.010	<0.05	<0.0005	84	<0.005	<0.05	<0.05	<0.005	27	<0.05	<0.0002	<0.005	<0.005	230	<0.05	
	MV1294-06	ND	ND	ND	101	ND	0.011	0.39	ND	31.5	0.50	ND	ND	ND	97.1	ND	ND
	MV1294-07	ND	ND	ND	218	ND	ND	0.85	ND	55.2	0.99	ND	ND	ND	192	ND	ND
	MV1294-08	ND	ND	ND	138	ND	ND	0.41	ND	34.0	0.51	ND	ND	ND	113	ND	ND
	MV1294-09	ND	ND	ND	199	ND	ND	0.98	ND	55.2	0.71	ND	ND	ND	206	ND	ND
	MV1294-10[2]	0.010	ND	ND	349	ND	ND	0.90	ND	90.6	1.15	ND	ND	ND	261	ND	ND
	MV1294-11[2]	0.011	ND	ND	353	ND	ND	0.91	ND	90.8	1.14	ND	ND	ND	254	ND	ND
	MV1294-12	ND	ND	ND	84	ND	0.011	0.17	ND	30.8	0.55	ND	ND	ND	254	ND	ND
	MV1294-13	ND	ND	ND	101	ND	ND	ND	ND	25.8	0.58	ND	ND	ND	98.5	ND	ND
Field Blank	MV1294-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV1294-15	<0.005	<0.05	<0.0005	400	<0.005	<0.05	0.28	<0.005	150	<0.05	<0.0002	<0.005	<0.005	690	<0.05	
	MV1294-16	0.010	0.12	ND	100	ND	0.017	0.11	ND	26.0	0.62	ND	ND	ND	90.3	ND	ND
	MV1294-17	<0.005	<0.05	<0.0005	150	<0.005	<0.05	0.84	<0.005	51	0.63	<0.0002	<0.005	<0.005	200	<0.05	
	MV1294-18	<0.005	<0.05	<0.0005	<0.05	<0.005	<0.05	<0.05	<0.005	<0.05	<0.05	<0.0002	<0.005	<0.005	<1.0	<0.05	
	MV1294-19	<0.005	<0.05	<0.0005	99	<0.005	<0.05	0.14	<0.005	31	<0.05	<0.0002	<0.005	<0.005	210	<0.05	
	MV1294-20[2]	0.016	0.12	<0.0005	220	0.009	<0.05	0.21	<0.005	79	<0.05	<0.0002	<0.005	<0.005	560	<0.05	
	MV1294-21[2]	ND	0.11	ND	234	0.012	0.016	0.26	ND	83.0	ND	ND	ND	ND	490	ND	ND
	MV1294-22	0.017	ND	ND	101	ND	0.028	0.21	ND	31.7	0.30	ND	ND	ND	167	ND	ND
	MV1294-23	0.012	ND	ND	126	ND	0.036	0.15	ND	12.9	ND	0.0017	ND	ND	257	ND	ND
	MV1294-24	ND	ND	ND	183	ND	ND	ND	ND	57.7	ND	ND	ND	ND	139	ND	ND

All Sample Units are mg/L Unless Otherwise Noted
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
December 1994 Sample Results

MCL		0.05	1.00	0.010		0.05			0.05			0.002	0.01	0.05		
SMCL							1.0	0.3			0.05				5.0	
								Metals								
	Sample #	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Selenium	Silver	Sodium	Zinc	Aluminum
	MV1294-25	ND	ND	ND	108	ND	ND	ND	ND	35.8	ND	ND	ND	ND	135	ND	ND
	MV1294-26	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Blank	MV1294-27	<0.010	<0.10	<0.0010	109	<0.010	0.010	<0.10	<0.005	31.7	0.43	<0.0005	0.007	<0.001	137	<0.05	<0.50
	MV1294-28	0.005	0.07	<0.0005	150	<0.005	<0.05	1.5	<0.005	40	0.36	<0.0002	<0.005	<0.005	360	<0.05	
	MV1294-29	<0.005	0.08	<0.0005	95	<0.005	<0.05	0.06	<0.005	12	<0.05	<0.0002	<0.005	<0.005	100	<0.05	
	MV1294-30[2]	0.013	<0.10	<0.0010	19.6	<0.010	<0.10	<0.10	<0.005	<1.0	<0.05	<0.0005	<0.005	<0.001	70.9	<0.05	<0.50
	MV1294-31[2]	0.021	<0.05	<0.0005	20	0.006	<0.05	<0.05	<0.005	0.46	<0.05	<0.0002	<0.005	<0.005	78	<0.05	
	MV1294-32	0.018	<0.10	<0.0010	12.7	0.019	<0.10	<0.10	<0.005	<1.0	<0.05	<0.0005	<0.010	<0.001	84.2	<0.05	<0.50
	MV1294-33	0.034	<0.10	<0.0010	15.7	0.022	0.010	0.24	<0.005	1.5	<0.05	<0.0005	<0.005	<0.001	196	<0.05	<0.50
	MV1294-34	0.031	<0.10	<0.0010	19.3	0.031	<0.010	0.10	<0.005	2.2	<0.05	<0.0005	<0.005	<0.001	193	<0.05	<0.50
	MV1294-35	ND	ND	ND	112	ND	0.039	0.10	0.014	23.0	ND	ND	ND	ND	145	0.12	ND
	MV1294-36	ND	ND	ND	131	ND	ND	0.10	ND	22.9	ND	ND	ND	ND	210	ND	ND
	MV1294-37	ND	ND	ND	91.5	ND	ND	0.14	ND	18.0	ND	ND	ND	ND	197	ND	ND
	MV1294-38	<0.005	0.06	<0.0005	230	<0.005	<0.05	<0.05	<0.005	72	<0.05	<0.0002	<0.005	<0.005	240	<0.05	
	MV1294-39	<0.005	<0.05	<0.0005	0.07	<0.005	<0.05	<0.05	<0.005	<0.20	<0.05	<0.0002	<0.005	<0.005	<0.50	<0.05	
Field Blank	MV1294-40[2]	<0.005	0.07	0.0021	110	<0.005	<0.05	0.73	0.006	26	0.72	<0.0002	<0.005	<0.005	98	<0.05	
	MV1294-41[2]	ND	ND	0.0014	110	ND	0.013	0.55	0.007	25.5	0.72	ND	ND	ND	87.9	ND	ND
Field Blank	MV1294-42	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Needles Bridge	MV1294-43[3]	ND	0.14	ND	84.7	ND	0.016	ND	ND	32.7	ND	ND	ND	ND	105	ND	ND
Laughlin Bridge	MV1294-44[3]	ND	0.14	ND	86.3	ND	0.017	ND	ND	33.1	ND	ND	ND	ND	106	ND	ND
	MV1294-45	<0.005	<0.05	<0.0005	76	<0.005	<0.05	<0.05	<0.005	26	0.06	<0.0002	<0.005	<0.005	89	<0.05	
	MV1294-46	0.009	<0.05	<0.0005	15	0.017	<0.05	<0.05	<0.005	1.7	<0.05	<0.0002	<0.005	<0.005	64	<0.05	
	MV1294-47	0.017	0.07	<0.0005	130	<0.005	<0.05	0.34	<0.005	34	0.53	<0.0002	<0.005	<0.005	130	<0.05	
	MV1294-48	<0.005	0.07	<0.0005	200	<0.005	<0.05	0.63	<0.005	52	1.0	<0.0002	<0.005	<0.005	270	<0.05	

All Sample Units are mg/L Unless Otherwise Noted
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
December 1994 Sample Results

MCL		0.05	1.00	0.010		0.05			0.05			0.002	0.01	0.05		
SMCL							1.0	0.3			0.05				5.0	
								Metals								
	Sample #	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Selenium	Silver	Sodium	Zinc	Aluminum
	MV1294-49	<0.005	0.12	<0.0005	260	<0.005	<0.05	0.67	<0.005	65	1.1	<0.0002	<0.005	<0.005	240	<0.05	
	MV1294-50[2]	ND	ND	ND	123	ND	ND	0.63	ND	38.6	0.90	ND	ND	ND	109	ND	ND
	MV1294-51[2]	<0.005	<0.05	<0.0005	120	<0.005	<0.05	0.61	<0.005	40	0.93	<0.0002	<0.005	<0.005	120	<0.05	
	MV1294-52	0.017	ND	ND	309	ND	0.020	0.23	0.007	81.2	0.33	ND	ND	ND	226	0.99	ND
	MV1294-53	<0.010	ND	ND	247	ND	0.010	6.72	ND	87.0	0.82	ND	ND	ND	536	ND	ND
Field Blank	MV1294-54	<0.005	<0.05	<0.0005	<0.05	<0.005	<0.05	<0.05	<0.005	<0.20	<0.05	<0.0002	<0.005	<0.005	<0.50	<0.05	
	MV1294-55	<0.005	0.10	<0.0005	250	<0.005	<0.05	0.63	<0.005	88	0.78	<0.0002	<0.005	<0.005	420	<0.05	
	MV1294-56	0.009	0.08	<0.0005	170	<0.005	<0.05	0.61	<0.005	49	0.73	<0.0002	<0.005	<0.005	210	<0.05	
	MV1294-57	0.022	ND	ND	101	ND	0.014	0.20	0.005	17.8	ND	ND	ND	ND	211	ND	ND
	MV1294-58	0.098	<0.05	<0.0005	77	<0.005	<0.05	<0.05	<0.005	11	<0.05	0.0006	<0.005	<0.005	220	<0.05	
	MV1294-59	0.168	<0.05	<0.0005	59	<0.011	<0.05	0.07	<0.005	8.8	<0.05	0.0004	<0.005	<0.005	190	<0.05	
	MV1294-60[2]	ND	ND	ND	235	ND	0.074	ND	0.011	94.0	ND	ND	ND	ND	525	ND	ND
	MV1294-61[2]	<0.005	<0.05	<0.0005	220	<0.005	<0.05	<0.05	<0.005	95	<0.05	0.0002	<0.005	<0.005	570	<0.05	
Field Blank	MV1294-62	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Blank	MV1294-63	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV1294-64	0.018	0.80	0.0010	228	0.013	0.415	35.2	0.017	65.0	1.17	ND	ND	ND	190	0.12	25.2
	MV1294-65	0.028	ND	ND	432	ND	ND	1.91	ND	125	1.47	ND	ND	ND	689	ND	ND
	MV1294-66	0.013	ND	ND	409	ND	ND	1.51	ND	121	1.38	ND	ND	ND	517	ND	ND
	MV1294-67	ND	ND	ND	203	ND	ND	0.54	ND	53.6	0.61	ND	ND	ND	290	ND	ND
	MV1294-68	ND	ND	ND	80.9	ND	ND	0.11	ND	24.6	ND	ND	ND	ND	221	ND	ND
	MV1294-69[2]	ND	ND	ND	176	ND	0.077	2.92	ND	54.9	0.78	ND	ND	ND	203	0.09	ND
	MV1294-70[2]	ND	ND	ND	173	ND	0.096	2.26	ND	53.8	0.76	ND	ND	ND	200	0.12	ND

All Sample Units are mg/L Unless Otherwise Noted
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
December 1994 Sample Results

MCL				4.0		10.0	1.0	10.0						
SMCL			250	2.0					250	500				6.5-8.5
							Non-Metals							
	Sample #	Alkalinity Phenol	Alkalinity mg/L as $CaCO_3$	Chloride	Fluoride	Hardness	Nitrate/ Nitrite as N	Nitrite as N (NO2-N)	Nitrate as N (NO3-N)	Sulfate	TDS	Specific Conductance	Turbidity (NTU)	pH (SU)
	MV1294-01		130	320	1.7	270	7.50			94	840	1,367		7.6
	MV1294-02	ND	170	283	0.63	556	1.07	ND	1.07	384	1220		0.04	7.83
Field Blank	MV1294-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		0.02	6.17
	MV1294-04	ND	151	108	0.50	358	<0.10	<0.10	<0.10	301	769		0.02	7.81
	MV1294-05		190	210	0.34	320	3.40			270	980	1,530		7.7
	MV1294-06	ND	160	95.5	0.34	375	<0.10	<0.10	<0.10	307	766		1.55	7.96
	MV1294-07	ND	242	231	0.24	745	<0.10	<0.10	<0.10	654	1540		8.7	7.95
	MV1294-08	ND	196	184	0.24	488	<0.10	<0.10	<0.10	289	969		3.0	7.92
	MV1294-09	ND	283	202	0.27	706	<0.10	<0.10	<0.10	638	1510		8.0	7.74
	MV1294-10[2]	ND	341	364	0.22	1,270	<0.10	<0.10	<0.10	952	2,380		9.2	7.92
	MV1294-11[2]	ND	345	431	0.22	1,290	<0.10	<0.10	<0.10	956	2,380		7.8	7.84
	MV1294-12	ND	231	324	0.48	343	<0.10	<0.10	<0.10	260	1,160		1.70	8.06
	MV1294-13	ND	148	88.8	0.29	348	<0.10	<0.10	<0.10	292	733		0.16	8.03
Field Blank	MV1294-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		0.01	6.44
	MV1294-15		250	690	0.16	1,600	9.00			1,600	3,800	4,790		7.3
	MV1294-16	ND	143	88.3	0.38	351	ND	ND	ND	293	725		0.32	8.09
	MV1294-17		200	180	0.24	580	<0.10			470	1,300	1,773		7.7
	MV1294-18		12	<5.0	<0.10	<0.50	<0.10			<5.0	<5.0	1.77		6.7
	MV1294-19		200	140	0.18	370	4.40			330	1,000	1,663		7.4
	MV1294-20[2]		250	870	0.20	870	7.20			310	2,500	3,875		7.3
	MV1294-21[2]	ND	247	1,000	0.28	902	6.06	ND	6.06	321	2,570		1.22	7.65
	MV1294-22	ND	152	322	0.23	379	ND	ND	ND	167	938		1.38	8.16

All Sample Units are mg/L Unless Otherwise Noted
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
December 1994 Sample Results

MCL					4.0		10.0	1.0	10.0					
SMCL				250	2.0					250	500			6.5-8.5
							Non-Metals							
	Sample #	Alkalinity Phenol	Alkalinity mg/L as $CaCO_3$	Chloride	Fluoride	Hardness	Nitrate/ Nitrite as N	Nitrite as N (NO2-N)	Nitrate as N (NO3-N)	Sulfate	TDS	Specific Conductance	Turbidity (NTU)	pH (SU)
	MV1294-23	ND	150	342	2.66	371	10.1	ND	10.1	275	1,200		0.44	7.93
	MV1294-24	ND	209	278	0.26	679	1.52	ND	1.52	427	1,270		0.11	7.72
	MV1294-25	ND	183	184	0.32	418	7.23	ND	7.23	255	894		0.21	7.65
Field Blank	MV1294-26	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		0.25	6.50
	MV1294-27	ND	180	131	0.30	402	0.82	ND	0.82	367	910		0.07	7.89
	MV1294-28		280	530	0.44	540	<0.10			320	1,700	2,570		7.3
	MV1294-29		110	220	0.66	190	6.05			130	620	1,132		7.4
	MV1294-30[2]	ND	129	17.8	3.30	49.8	5.65	ND	5.65	32.2	297		0.05	7.96
	MV1294-31[2]		140	21	3.3	52	6.20			34	280	429		7.8
	MV1294-32	ND	133	28.4	3.62	33.2	5.36	ND	5.36	40.0	338		0.26	8.14
	MV1294-33	ND	116	221	3.36	48.6	6.77	ND	6.77	73.1	666		0.72	8.31
	MV1294-34	ND	122	218	3.62	61.8	7.13	ND	7.13	87.5	693		0.35	8.29
	MV1294-35	ND	115	355	0.59	400	2.06	ND	2.06	163	966		0.69	7.71
	MV1294-36	ND	114	519	0.43	451	1.10	ND	1.10	159	1,250		0.21	7.74
	MV1294-37	ND	94.0	381	1.19	307	5.49	ND	5.49	153	966		0.45	7.87
	MV1294-38		180	410	0.17	870	18.1			680	1,700	2,520		7.1
Field Blank	MV1294-39		<5.0	<5.0	<0.10	<1.0	<0.10			<5.0	<5.0	3.0		8.0
	MV1294-40[2]		180	120	0.47	380	<0.10			270	690	1,154		7.5
	MV1294-41[2]	ND	169	124	0.63	367	ND	ND	ND	222	697		4.2	7.68
Field Blank	MV1294-42	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		0.06	7.04
Needles Bridge	MV1294-43[3]	ND	129	95.2	0.35	328	0.25	ND	0.25	310	7.07		0.20	8.24
Laughlin Bridge	MV1294-44[3]	ND	128	95.0	0.37	328	0.23	ND	0.23	308	7.41		0.42	8.30
	MV1294-45		150	69	0.32	300	0.284			290	620	923		7.5

All Sample Units are mg/L Unless Otherwise Noted
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

December 1994 Sample Results

MCL				4.0		10.0	1.0	10.0						
SMCL			250	2.0					250	500				6.5-8.5
							Non-Metals							
	Sample #	Alkalinity Phenol	Alkalinity mg/L as $CaCO_3$	Chloride	Fluoride	Hardness	Nitrate/ Nitrite as N	Nitrite as N (NO2-N)	Nitrate as N (NO3-N)	Sulfate	TDS	Specific Conductance	Turbidity (NTU)	pH (SU)
	MV1294-46		110	20	0.64	44	5.15			51	240	373		8.0
	MV1294-47		200	160	0.21	460	<0.10			320	880	1,358		7.4
	MV1294-48		260	220	0.19	710	<0.10			640	1,600	2,140		7.4
	MV1294-49		250	400	0.16	920	<0.10			520	1,800	2,530		7.40
	MV1294-50[2]	ND	242	96.4	0.35	442	ND	ND	ND	338	883		4.1	7.93
	MV1294-51[2]		250	90	0.25	460	<0.10			270	910	1,268		7.7
	MV1294-52	ND	301	264	ND	1,020	ND	ND	ND	907	2,000		1.44	7.55
	MV1294-53	ND	314	600	0.61	912	ND	ND	ND	975	2670		91	7.64
Field Blank	MV1294-54		<5.0	<5.0	<0.10	<1.0	<0.10			<5.0	<5.0	1.8		7.0
	MV1294-55		190	810	0.14	990	<0.10			390	2,100	3,340		7.3
	MV1294-56		230	320	0.18	630	<0.10			340	1,300	2,160		7.6
	MV1294-57	ND	129	305	1.93	323	0.81	ND	0.81	225	1000		0.52	7.91
	MV1294-58		120	300	2.2	240	0.942			200	910	1,512		7.5
	MV1294-59		120	210	3.8	180	3.56			190	790	1,253		7.5
	MV1294-60[2]	ND	356	541	0.28	975	15.9	ND	15.9	867	2560		0.38	7.56
	MV1294-61[2]		120	540	0.24	940	15.0			1,000	2,600	3,655		7.0
Field Blank	MV1294-62	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		0.07	5.94
Field Blank	MV1294-63	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		0.66	5.64
	MV1294-64	ND	382	230	0.34	840	ND	ND	ND	294	1510		340	7.15
	MV1294-65	ND	174	1570	ND	1730	ND	ND	ND	752	3840		21	7.71
	MV1294-66	ND	364	689	ND	1530	ND	ND	ND	1260	3350		23	7.77
	MV1294-67	ND	247	392	0.20	723	ND	ND	ND	511	1660		5.6	8.04
	MV1294-68	ND	158	176	0.46	304	5.70	ND	5.70	517	992		0.17	7.79
	MV1294-69[2]	ND	238	170	0.35	666	ND	ND	ND	524	1300		21	8.13
	MV1294-70[2]	ND	241	169	0.38	646	ND	ND	ND	521	1270		21	7.69

All Sample Units are mg/L Unless Otherwise Noted
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
December 1994 Sample Results

MCL	5.0	100	600		75	700	1000			
SMCL										

	VOC's						Xylene (Total) MCL = 10000			
Sample #	Benzene	Chlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Ethylbenzene	Toluene	m,p-Xylene	o-Xylene	Surrogate Recovery (%) 1-Chloro-2-fluorobenzene
MV1294-01[1]										
MV1294-02[1]										
MV1294-03[1]										
MV1294-04[1]										
MV1294-05[1]										
MV1294-06[1]										
MV1294-07[1]										
MV1294-08[1]										
MV1294-09[1]										
MV1294-10[1]										
MV1294-11[1]										
MV1294-12[1]										
MV1294-13[1]										
MV1294-14[1]										
MV1294-15	ND	ND	ND	ND	ND	ND	ND	ND	ND	93
MV1294-16[1]										
MV1294-17	ND	ND	ND	ND	ND	ND	ND	ND	ND	98
MV1294-18	ND	ND	ND	ND	ND	ND	ND	ND	ND	95
MV1294-19	ND	ND	ND	ND	ND	ND	ND	ND	ND	96
MV1294-20[2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	93
MV1294-21[2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	93
MV1294-22[1]										

All Sample Units are ug/L Unless Otherwise Noted
[1] Not Sampled for VOC's
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
December 1994 Sample Results

		VOC's									
									Xylene (Total) MCL = 10,000		
	Sample #	Benzene	Chlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Ethylbenzene	Toluene	m,p-Xylene	o-Xylene	Surrogate Recovery (%) 1-Chloro-2-fluorobenzene
MCL		5.0	100	600		75	700	1000			
SMCL											
	MV1294-23[1]										
	MV1294-24[1]										
	MV1294-25[1]										
	MV1294-26[1]										
	MV1294-27[1]										
	MV1294-28[1]										
	MV1294-29[1]										
	MV1294-30[2][1]										
	MV1294-31[2][1]										
	MV1294-32[1]										
	MV1294-33[1]										
	MV1294-34[1]										
	MV1294-36[1]										
	MV1294-37[1]										
	MV1294-38	ND	ND	ND	ND	ND	ND	ND	ND	ND	86
	MV1294-39[1]										
	MV1294-40[2][1]										
	MV1294-41[2][1]										
	MV1294-42[1]										
Needles Bridge	MV1294-43[3]										
Laughlin Bridge	MV1294-44[3]										

All Sample Units are ug/L Unless Otherwise Noted
[1] Not Sampled For VOC's
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
December 1994 Sample Results

MCL	5.0	100	600		75	700	1000			
SMCL										

	VOC's							Xylene (Total) MCL = 10,000		
Sample #	Benzene	Chlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Ethylbenzene	Toluene	m,p-Xylene	o-Xylene	Surrogate Recovery (%) 1-Chloro-2-fluorobenzene
MV1294-45[1]										
MV1294-46[1]										
MV1294-47[1]										
MV1294-48	ND	ND	ND	ND	ND	ND	ND	ND	ND	83
MV1294-49	ND	ND	ND	ND	ND	ND	ND	ND	ND	88
MV1294-50[2][1]										
MV1294-51[2][1]										
MV1294-52[1]										
MV1294-53[1]										
MV1294-54[1]										
MV1294-55[1]										
MV1294-56[1]										
MV1294-57[1]										
MV1294-58[1]										
MV1294-59[1]										
MV1294-60[2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	97
MV1294-61[2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	98
MV1294-62	ND	ND	ND	ND	ND	ND	ND	ND	ND	97
MV1294-63	ND	ND	ND	ND	ND	ND	ND	ND	ND	92
MV1294-64	85	ND	ND	ND	ND	ND	ND	ND	ND	90
MV1294-65[1]										
MV1294-66[1]										
MV1294-67[1]										
MV1294-68[1]										
MV1294-69[1]										
MV1294-70[1]										

All Sample Units are ug/L Unless Otherwise Noted
[1] Not Sampled For VOC's
[2] Duplicate Sample
[3] Surface Water Sample
ND Not Detected

Appendix A
December 1994 Sample Results

Sample #	Pesticides/Herbicides 2,4-D	Methomyl	Chlordimeform	Trifluralin	Monocrotophos	Metribuzin	Methyl Parathion	Malathion	Chloropyrifos	Cypermethrin	Phthalates
MV1294-01[4]											
MV1294-02[4]											
MV1294-03[4]											
MV1294-04[4]											
MV1294-05[4]											
MV1294-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MV1294-07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MV1294-08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MV1294-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MV1294-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MV1294-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MV1294-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MV1294-13[4]											
MV1294-14[4]											
MV1294-15[4]											
MV1294-16[4]											
MV1294-17[4]											
MV1294-18[4]											
MV1294-19[4]											
MV1294-20[4]											
MV1294-21[4]											
MV1294-22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MV1294-23[4]											
MV1294-24[4]											
MV1294-25[4]											
MV1294-26[4]											
MV1294-27[4]											

All Sample Units are ug/l Unless Otherwise Noted
* Did not meet QA Standards
[3] Surface Water Sample
[4] Not Sampled For Pest/Herb
ND Not Detected

Appendix A
December 1994 Sample Results

		Pesticides/Herbicides										
	Sample #	2,4-D	Methomyl	Chlordimeform	Trifluralin	Monocrotophos	Metribuzin	Methyl Parathion	Malathion	Chloropyrifos	Cypermethrin	Phthalates
	MV1294-28[4]											
	MV1294-29[4]											
	MV1294-30[24]											
	MV1294-31[24]											
	MV1294-32[4]											
	MV1294-33[4]											
	MV1294-34[4]											
	MV1294-36[4]											
	MV1294-37[4]											
	MV1294-38[4]											
	MV1294-39[4]											
	MV1294-40[24]											
	MV1294-41[24]											
	MV1294-42[4]											
Needles Bridge	MV1294-43[34]											
Laughlin Bridge	MV1294-44[34]											
	MV1294-45	<20.0	<5.0	<5.0	<5.0	<50.0	<5.0	<5.0	<5.0	<5.0	<5.0	
	MV1294-46	<20.0	<5.0	<5.0	<5.0	<50.0	<5.0	<5.0	<5.0	<5.0	<5.0	
	MV1294-47	<20.0	<5.0	<5.0	<5.0	<50.0	<5.0	<5.0	<5.0	<5.0	<5.0	
	MV1294-48	<20.0	<5.0	<5.0	<5.0	<50.0	<5.0	<5.0	<5.0	<5.0	<5.0	
	MV1294-49	<20.0	<5.0	<5.0	<5.0	<50.0	<5.0	<5.0	<5.0	<5.0	<5.0	
	MV1294-50[2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV1294-51[2]	<20.0	<5.0	<5.0	<5.0	<50.0	<5.0	<5.0	<5.0	<5.0	<5.0	
	MV1294-52	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV1294-53	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV1294-54	<20.0	<5.0	<5.0	<5.0	<50.0	<5.0	<5.0	<5.0	<5.0	<5.0	
	MV1294-55	<20.0	<5.0	<5.0	<5.0	<50.0	<5.0	<5.0	<5.0	<5.0	<5.0	
	MV1294-56	<20.0	<5.0	<5.0	<5.0	<50.0	<5.0	<5.0	<5.0	<5.0	<5.0	

All Sample Units are ug/l Unless Otherwise Noted
[*] Did not meet QA Standards
[3] Surface Water Sample
[4] Not Sampled for Pest/Herb
ND Not Detected

Appendix A
December 1994 Sample Results

Sample #	Pesticides/Herbicides 2,4-D	Methomyl	Chlordimeform	Trifluralin	Monocrotophos	Metribuzin	Methyl Parathion	Malathion	Chloropyrifos	Cypermethrin	Phthalates
MV1294-57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MV1294-58[4]											
MV1294-59[4]											
MV1294-60[3,4]											
MV1294-61[3,4]											
MV1294-62[4]											
MV1294-63[4]											
MV1294-64[4]											
MV1294-65	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MV1294-66	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MV1294-67	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MV1294-68[4]											
MV1294-69[2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MV1294-70[2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

All Sample Units are ug/l Unless Otherwise Noted
[2] Did not meet QA Standards
[3] Surface Water Sample
[4] Not Sampled for Pest/Herb
ND Not Detected

Appendix A
December 1994 Sample Results

	Pesticides/Herbicides				
Sample #	**Butifos**	**Ethyl parathion**	**Fluazifop-butyl**	**Azinphos-methyl**	**Permethrin**
MV1294-01[4]					
MV1294-02[4]					
MV1294-03[4]					
MV1294-04[4]					
MV1294-05[4]					
MV1294-06	ND	ND	ND	ND	ND
MV1294-07	ND	ND	ND	ND	ND
MV1294-08	ND	ND	ND	ND	ND
MV1294-09	ND	ND	ND	ND	ND
MV1294-10[2]	ND	ND	ND	ND	ND
MV1294-11[2]	ND	ND	ND	ND	ND
MV1294-12	ND	ND	ND	ND	ND
MV1294-13[4]					
MV1294-14[4]					
MV1294-15[4]					
MV1294-16[4]					
MV1294-17[4]					
MV1294-18[4]					
MV1294-19[4]					
MV1294-20[24]					
MV1294-21[24]					
MV1294-22	ND	ND	ND	ND	ND
MV1294-23[4]					
MV1294-24[4]					
MV1294-25[4]					
MV1294-26[4]					
MV1294-27[4]					
MV1294-28[4]					

All Sample Units are ug/l Unless Otherwise Noted
* Did not meet QA Standards
[3] Surface Water Sample
[4] Not Sampled for Pest/Herb
ND Not Detected

Appendix A
December 1994 Sample Results

	Pesticides/Herbicides				
Sample #	**Butifos**	**Ethyl parathion**	**Fluazifop-butyl**	**Azinphos-methyl**	**Permethrin**
MV1294-57[4]					
MV1294-58[4]					
MV1294-59[4]					
MV1294-60[2,4]					
MV1294-61[2,4]					
MV1294-62[4]					
MV1294-63[4]					
MV1294-64[4]					
MV1294-65	ND	ND	ND	ND	ND
MV1294-66	ND	ND	ND	ND	ND
MV1294-67	ND	ND	ND	ND	ND
MV1294-68[4]					
MV1294-69[2]	ND	ND	ND	ND	ND
MV1294-70[2]	ND	ND	ND	ND	ND

All Sample Units are ug/L Unless Otherwise Noted
[1] Did not meet QA Standards
[3] Surface Water Sample
[4] Not Sampled for Pest/Herb
ND Not Detected

Appendix A
February 1994 Sample Results

MCL		0.05	1.00	0.010		0.05				0.05			0.002	0.01	0.05		
SMCL							1.0	0.3				0.05				5.0	
								Metals									
	Sample #	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Selenium	Silver	Sodium	Zinc	Aluminum
	MV295-01	0.015	ND	ND	94.0	ND	ND	ND	ND	9.8	ND	0.0009	ND	ND	236	ND	ND
Field Blank	MV295-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MV295-03	0.016	0.30	ND	240	0.017	0.017	12.2	0.016	71.4	1.20	ND	ND	ND	183	0.13	9.00
	MV295-04	0.12	<0.05	<0.0005	64	0.009	<0.05	<0.05	<0.005	8.7	<0.05	<0.0002	<0.005	<0.005	190	<0.05	
	MV295-05	0.133	ND	ND	60.6	0.016	ND	ND	ND	8.7	ND	ND	ND	ND	187	ND	ND
	MV295-06	<0.005	0.13	<0.0005	120	<0.005	<0.05	0.07	<0.005	16	<0.05	<0.0002	<0.005	<0.005	96	<0.05	
	MV295-07	0.082	<0.05	<0.0005	89	<0.005	<0.05	0.11	<0.005	12	<0.05	0.0004	<0.005	<0.005	190	<0.05	
	MV295-08	0.094	<0.05	<0.0005	81	<0.005	<0.05	<0.05	<0.005	11	<0.05	0.0003	<0.005	<0.005	210	<0.05	

MCL						4.0		10.0	1.0	10.0							
SMCL					250	2.0					250	500			6.5-8.5		
								Non-Metals									
	Sample #	Alkalinity, Phenol	Alkalinity mg/L as $CaCO_3$	Chloride	Fluoride	Hardness	Nitrate/ Nitrite as N	Nitrite as N (NO2-N)	Nitrate as N (NO3-N)	Sulfate	TDS	Specific Conductance	Turbidity (NTU)	pH (SU)			
	MV295-01	ND	134	295	3.30	283	13.2	ND	13.2	218	1,050		0.13	7.52			
Field Blank	MV295-02	ND	3.1	ND	ND	ND	ND	ND	ND	ND	ND	0	0.08	6.88			
	MV295-03	ND	325	165	0.37	628	ND	ND	ND	289	1110		348	7.47			
	MV295-04		120	210	3.6	200	2.38			130	760	1,256		7.5			
	MV295-05	ND	119	213	3.85	188	1.98	ND	1.98	159	769		0.06	7.72			
	MV295-06		100	190	0.58	370	5.30			110	710	1,126		7.6			
	MV295-07		120	280	1.7	270	5.72			100	850	1,393		7.5			
	MV295-08		120	290	2.3	250	0.914			140	900	1,474		7.5			

All Sample Units are ug/L Unless Otherwise Noted

Appendix A
February 1995 Sample Results

MCL		5.0	100	600		75	700	1000			
SMCL											

					VOC's			Xylene (Total) MCL = 10000			
	Sample #	Benzene	Chlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Ethylbenzene	Toluene	m,p-Xylene	o-Xylene	Surrogate Recovery (%)
	MV295-01[1]										
Field Blank	MV295-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	105
	MV295-03	6.3	ND	ND	ND	ND	ND	ND	5.3	ND	104
	MV295-04[1]										
	MV295-05[1]										
	MV295-06[1]										
	MV295-07[1]										
	MV295-08[1]										

					Pesticides/Herbicides					
	Sample #	2,4-D	Methomyl	Chlordimeform	Trifluralin	Monocrotophos	Metribuzin	Methyl Parathion	Malathion	Chloropyrifos	Cypermethrin	Phthalates
	MV295-01[4]											
Field Blank	MV295-02[4]											
	MV295-03[4]											
	MV295-04[4]											
	MV295-05[4]											
	MV295-06[4]											
	MV295-07[4]											
	MV295-08[4]											

					Pesticides/Herbicides	
	Sample #	Butifos	Ethyl parathion	Fluazifop-butyl	Azinphos-methyl	Permethrin
	MV295-01[4]					
Field Blank	MV295-02[4]					
	MV295-03[4]					
	MV295-04[4]					
	MV295-05[4]					
	MV295-06[4]					
	MV295-07[4]					
	MV295-08[4]					

All Sample Units are ug/L Unless Otherwise Noted
[4] Not Sampled for Pest/Herb
[1] Not Sampled for VOC's

Appendix B

Field Parameters

Sample #	ADEQ#		Date	Temp (°F)	pH (SU)	S.C.* (uhmos)	Date	Temp (°F)	pH (SU)	S.C.* (uhmos)	Date	Temp (°F)	pH (SU)	S.C.* (uhmos)
MV694-01	MV1294-05	46077	3/14/94	81.3	8.37	1700	6/6/94	85.6	7.59	1438	11/29/94	73.5	6.57	1482
MV694-02	MV1294-46	21177	3/01/94	89.2	7.97	391	6/6/94	92.7	8.12	320	12/7/94	76.2	6.20	484
MV694-04	MV1294-45	46066	2/22/94	66.3	7.58	659	6/6/94	72.6	7.76	940	12/7/94	62.8	6.45	926
MV694-05	MV1294-38	21610	3/01/94	77.0	7.19	2190	6/7/94	81.8	6.84	247	12/6/94	78.6	6.78	9080
MV894-03	MV1294-40,41	01280	3/01/94	75.2	7.42	1090	6/7/94	79.9	7.60	1300	12/6/94	76.7	6.38	1553
MV894-04	MV1294-28	46282	3/17/94	69.3	7.20	2170	6/7/94	88.3	7.42	2850	12/6/94	70.6	6.02	2790
MV694-09	MV1294-29	46281	3/17/94	84.6	7.54	903	6/7/94	87.3	7.71	856	12/6/94	88.6	7.22	986
MV694-10	MV1294-17	46082	3/02/94	76.3	7.46	1640	6/7/94	80.6	7.90	1277	12/1/94	62.5	6.51	1803
MV694-11	MV1294-20,21	46079	3/03/94	80.8	7.12	3760	6/7/94	89.0	7.00	3330	12/1/94	78.9	6.11	3960
MV694-12	MV1294-55	46059	3/02/94	69.5	7.43	2970	6/8/94	78.6	7.62	3180	12/8/94	67.4	6.03	3460
MV694-13	MV1294-01	46084	3/15/94	89.3	7.01	1320	6/7/94	86.2	7.53	1314	11/29/94	80.2	6.91	922
MV694-14,15	MV1294-19	46081	3/15/94	79.8	6.99	1550	6/7/94	83.8	7.38	1444	12/1/94	65.2	6.54	1611
MV694-16	MV1294-15	46083	3/15/94	76.0	6.80	4210	6/7/94	80.8	7.14	3770	12/1/94	63.8	6.10	5170
MV694-17[3]	MV1294-43		NA	NA	NA	NA	6/8/94	77.0	8.09	1054	12/7/94	60.8	7.35	1270
MV694-18[3]	MV1294-44		NA	NA	NA	NA	6/8/94	80.0	8.09	1043	12/7/94	63.2	7.30	1400
MV694-19	MV1294-47	46293	NA	NA	NA	NA	6/9/94	72.5	7.54	1229	12/8/94	61.8	6.02	1315
MV694-20	MV1294-49	46294	NA	NA	NA	NA	6/9/94	75.4	7.41	2340	12/8/94	65.8	6.06	2750
MV694-21,22	MV1294-48	46068	NA	NA	NA	NA	6/9/94	76.6	7.29	1928	12/8/94	66.1	6.07	2410
MV694-24	MV1294-56	46061	3/03/94	71.1	7.61	2140	6/9/94	78.9	7.17	1574	12/8/94	68.6	6.41	1965
MV694-25	MV1294-04	46075	3/14/94	79.4	7.53	1070	6/13/94	85.1	7.49	1023	11/29/94	76.0	6.70	1196
MV694-27	MV1294-02	46088	3/16/95	84.2	7.42	1880	6/13/94	80.1	7.59	1219	11/29/94	67.8	6.45	1337
MV694-28	MV1294-16	46090	3/16/94	78.1	7.73	945	6/13/94	78.1	6.02	913	12/1/94	64.5	6.60	1121
MV694-29	MV1294-34	46092	NA	NA	NA	NA	6/14/94	92.0	8.36	952	12/6/94	99.8	8.57	1138
MV694-30	MV1294-33	46091	NA	NA	NA	NA	6/14/94	88.7	8.13	1029	12/6/94	88.7	7.51	995
MV694-31	MV1294-35	46094	3/01/94	73.9	7.61	545	6/14/94	83.5	7.27	1370	12/6/94	99.7	9.08	1613
MV694-32	MV1294-36	46093	3/01/94	70.6	7.51	898	6/14/94	86.2	7.52	1641	12/6/94	96.1	8.47	3260
MV694-33	MV1294-37	21809	NA	NA	NA	NA	6/14/94	85.6	7.77	1546	12/6/94	98.3	8.54	453
MV694-34,35	MV1294-32	21807	3/01/94	88.0	7.86	999	6/14/94	96.9	7.91	497	12/6/94	105.1	8.09	535
MV694-36	MV1294-30,31	21806	3/01/94	102.0	7.65	385	6/14/94	101.8	7.81	361	12/6/94	102.8	7.17	423
MV694-37	NA	46060	2/24/94	69.3	7.26	1390	6/14/94	85.8	6.93	1182	NA	NA	NA	NA
MV694-38	MV1294-69,70	46067	3/02/94	77.0	7.93	1730	6/14/94	86.3	7.24	1710	12/13/94	68.8	6.43	1967
MV694-39	MV1294-67	46001	2/24/94	56.1	7.69	3050	6/14/94	85.8	7.32	2350	12/13/94	63.0	6.71	2620
MV694-40	MV1294-22	46070	2/23/94	NA	7.71	NA	6/14/94	79.8	7.23	1191	12/1/94	72.0	6.25	1653
MV694-42	MV1294-13	46089	3/14/94	74.8	7.53	1070	6/14/94	72.8	7.60	916	11/30/94	64.9	6.71	1071

Sample #	ADEQ#	Date	Temp (°F)	pH (SU)	S.C.* (uhmos)	Date	Temp (°F)	pH (SU)	S.C.* (uhmos)	Date	Temp (°F)	pH (SU)	S.C.* (uhmos)
MV694-43,44	MV1294-57 46086	3/16/94	77.1	7.96	1980	6/15/94	86.8	7.24	1705	12/12/94	80.6	6.79	1456
MV694-45	MV1294-66 46062	3/02/94	74.7	7.84	4020	6/15/94	76.9	7.21	3950	12/13/94	68.5	6.25	4770
MV694-46	MV1294-12 46069	3/03/94	69.5	7.58	1410	6/15/94	79.5	7.46	782	11/30/94	71.6	6.45	1881
MV694-47	MV1294-25 46078	3/14/94	84.2	7.41	1320	6/15/94	82.5	7.07	302	12/5/94	72.8	6.64	1359
MV694-48	MV1294-68 46074	3/14/94	80.4	7.68	1940	6/15/94	86.8	7.32	457	12/13/94	73.2	6.74	1557
MV694-49	MV1294-27 46080	3/16/94	80.8	7.68	1980	6/15/94	79.5	7.30	303	12/5/94	64.6	6.85	1343
MV694-51	MV1294-60,61 00324	2/24/94	62.7	6.97	9720	6/16/94	77.0	6.82	2760	12/12/94	66.7	6.70	3710
MV694-53	MV1294-64 46096	NA	NA	NA	NA	6/16/94	76.5	7.01	461	12/13/94	66.3	6.27	1757
MV694-54	MV1294-10,11 45997	3/02/94	63.7	7.64	1180	6/27/94	77.9	7.09	2480	11/30/94	70.6	5.90	3000
MV694-55	MV1294-09 45998	3/02/94	66.1	7.46	2150	6/27/94	78.6	7.33	1898	11/30/94	70.4	6.19	2260
MV694-56	MV1294-08 46292	3/02/94	65.5	7.26	2350	6/27/94	81.2	7.43	1136	11/30/94	69.5	6.14	1580
MV694-57	MV1294-07 45994	3/02/94	66.2	7.47	2295	6/27/94	79.4	7.30	1543	11/30/94	65.4	6.19	2320
MV694-58	MV1294-06 45999	3/02/94	67.3	7.60	1460	6/27/94	79.4	7.94	940	11/30/94	61.7	6.41	1247
MV694-59	MV1294-24 46076	3/14/94	80.6	7.45	1600	6/27/94	82.9	6.71	1607	12/5/94	73.7	6.45	1785
MV694-61	MV1294-23 46085	3/15/94	72.0	7.10	1620	6/27/94	87.8	7.00	580	12/5/94	71.7	6.30	2010
MV694-62	MV1294-50,51 46295	NA	NA	NA	NA	6/28/94	76.3	6.89	1405	12/8/94	62.8	6.32	1409
MV694-63	MV1294-52 46297	NA	NA	NA	NA	6/28/94	78.0	6.89	2120	12/8/94	65.1	6.15	2970
MV694-65,66	MV1294-53 46296	NA	NA	NA	NA	6/28/94	82.2	7.01	3520	12/8/94	64.8	6.14	3610
	MV1294-58 46597	NA	NA	NA	NA	NA	NA	NA	NA	12/12/94	77.6	6.83	1251
	MV1294-59 46596	NA	NA	NA	NA	NA	NA	NA	NA	12/12/94	80.6	6.91	1070
	MV1294-65 46595	NA	NA	NA	NA	NA	NA	NA	NA	12/13/94	64.9	6.02	6220

[3] Surface Water Sample
**Specific Conductance
NA Not Analyzed

Appendix C

"GROUNDWATER QUALITY IN THE BULLHEAD CITY AREA, MOHAVE COUNTY, ARIZONA"

Groundwater Quality in the Bullhead City area, Mohave County, Arizona

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

November, 1989

Prepared by Cynthia M. Darr

Figures drafted by Marcy M. Mullins

EXECUTIVE SUMMARY

Bullhead City is the fastest growing area in Arizona. The population has increased dramatically in the last five years in response to the construction of casinos across the river in Laughlin, Nevada.

As a result of population growth and wastewater disposal practices, the Arizona Department of Environmental Quality (ADEQ) has conducted a number of studies in the area. This report is a consolidation of three separate sampling efforts by ADEQ: a field reconnaissance of groundwater quality, a nitrogen isotope study, and a virus study. The results of the studies show that there are three influences on groundwater quality: recharge from the Colorado River, recharge from septic systems, and local hydrogeology. The results also indicate that septic systems have affected groundwater quality in the old Bullhead City area and parts of Riviera. The existence of high nitrates, chlorides, and total dissolved solids in groundwater documented in the study. The constituent of most concern is nitrate due to its potential health impact, its widespread occurrence and its anthropogenic source. Preliminary results from the nitrogen isotope study indicate that the source of high nitrates in groundwater is domestic wastewater. There were no viruses detected in groundwater.

INTRODUCTION

Bullhead City is located along the Colorado River in Mohave County in the northwestern section of the state (figure 1). The Bullhead City study area encompasses a thirty square mile area including old Bullhead City, Riveria and a part of Fort Mohave. The Bullhead City area is the fastest growing area in the state at this time.

In September 1987, the Arizona Department of Environmental Quality (ADEQ) conducted a field reconnaissance of groundwater quality in the Bullhead City area. Additional information was collected in August 1988 for a nitrogen isotope study and in May of 1989 as part of a state-wide virus study. Hydrologists measured water table depth and sampled groundwater quality in an attempt to better understand the regional hydrogeology. Our objectives in this investigation were to assess the impact of current wastewater disposal practices on groundwater quality and to obtain background information to be used in reviewing permit applications for discharging facilities.

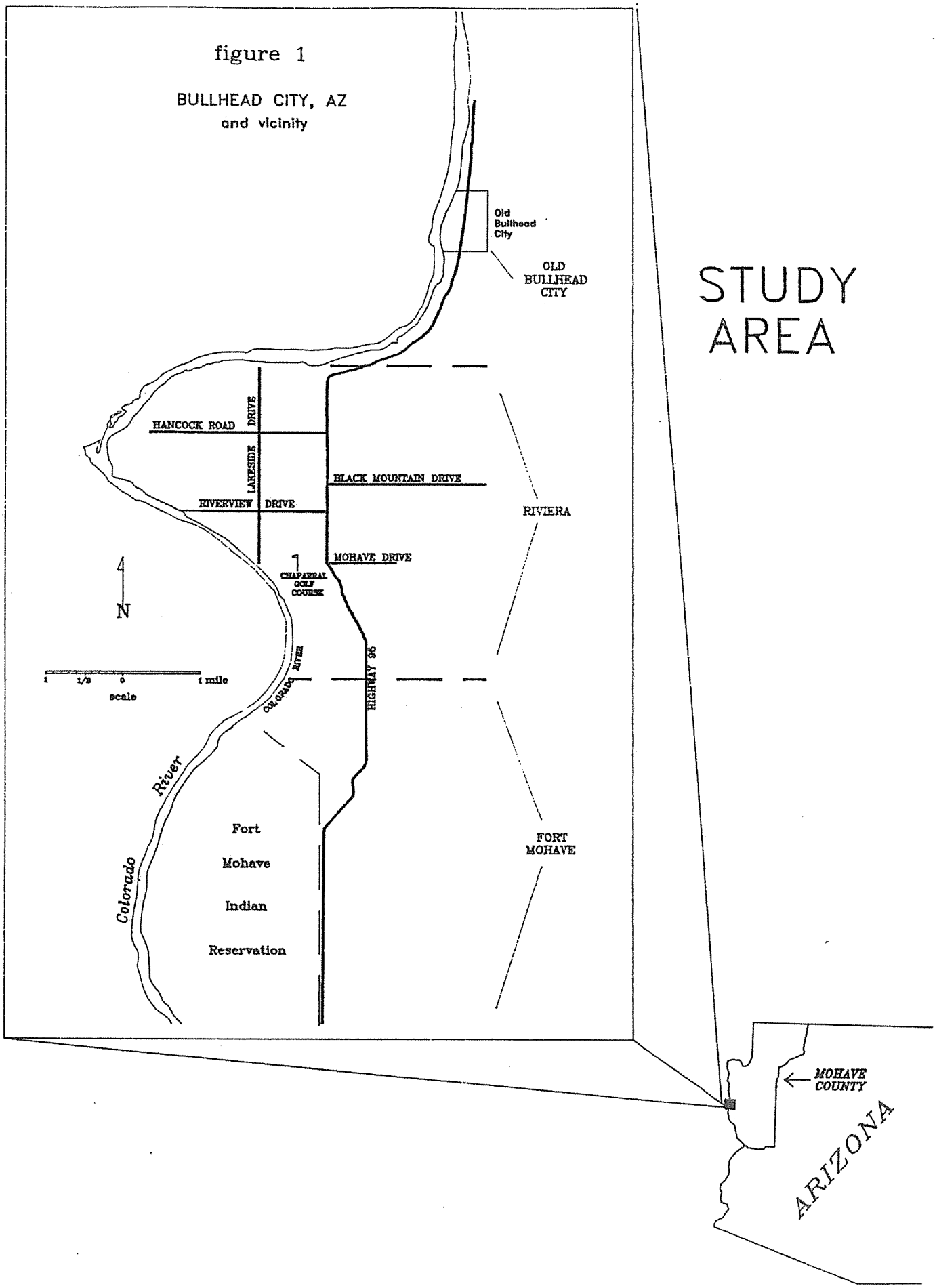
The majority of the wastewater disposal in the study area has predominantly been through septic systems. Although there are three sanitary districts in the area they serve only a small percentage of the area. A map showing the distribution of sewered areas is included in figure 2. Due to the rapid growth of Bullhead City and surrounding areas and the increased use of septic systems the potential for groundwater contamination exists. The constituents of concern from these systems are nitrates, phosphates, salts, microbiological organisms, and total dissolved solids.

Population Growth

The Bullhead City area has experienced rapid population growth in the last five years, primarily due to the construction of casinos on the Nevada side of the Colorado River in Laughlin. As of the date of this report, Laughlin has plans for a total of 28 casinos. At least 4 new casinos are under construction now, one of which will be the largest in the world. Each casino requires at least 3,000 workers and housing is not readily available on the Nevada side. Therefore, all casino workers must reside on the Arizona side in Bullhead City. The population has tripled in the past 5 years and is expected to double again in the next 7 years. In 1985 the population was 17,091 with a seasonal influx of 5,100 people. Over half of all housing units are mobile homes. Table 1 which shows building permits for 1988 and 1989 illustrates the tremendous population growth in the last two years.

figure 1

BULLHEAD CITY, AZ
and vicinity



SEWERED AREAS and HOUSING DENSITIES

BULLHEAD CITY, AZ
and vicinity

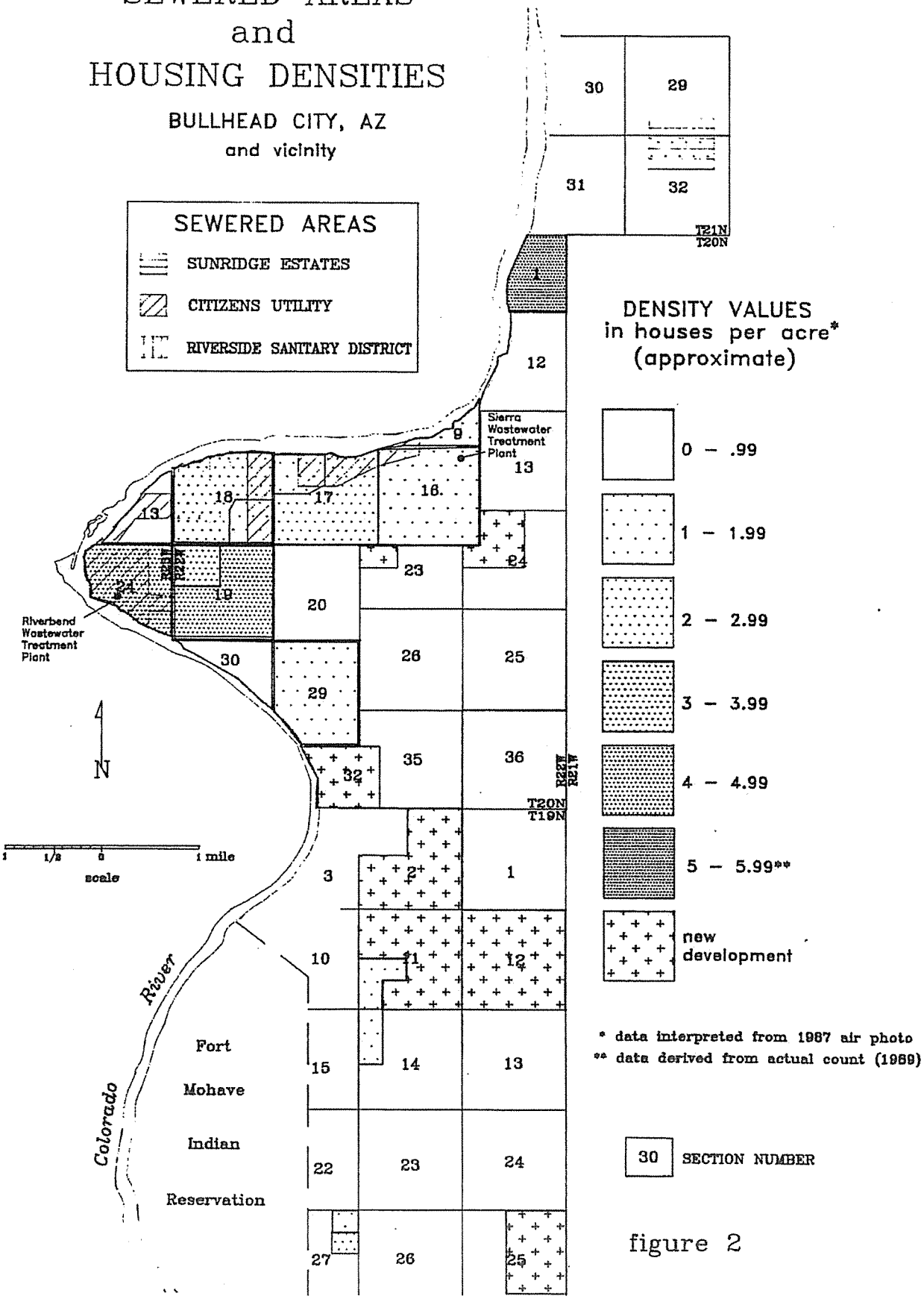


figure 2

Table #1

Building Permits Issued

	1988	1989*
Single Family Residences	202	313
Mobile Homes	244	513
Multi-Units	7	28
	453	853

Stanley C. Cohen, SRA Real Estate Appraiser

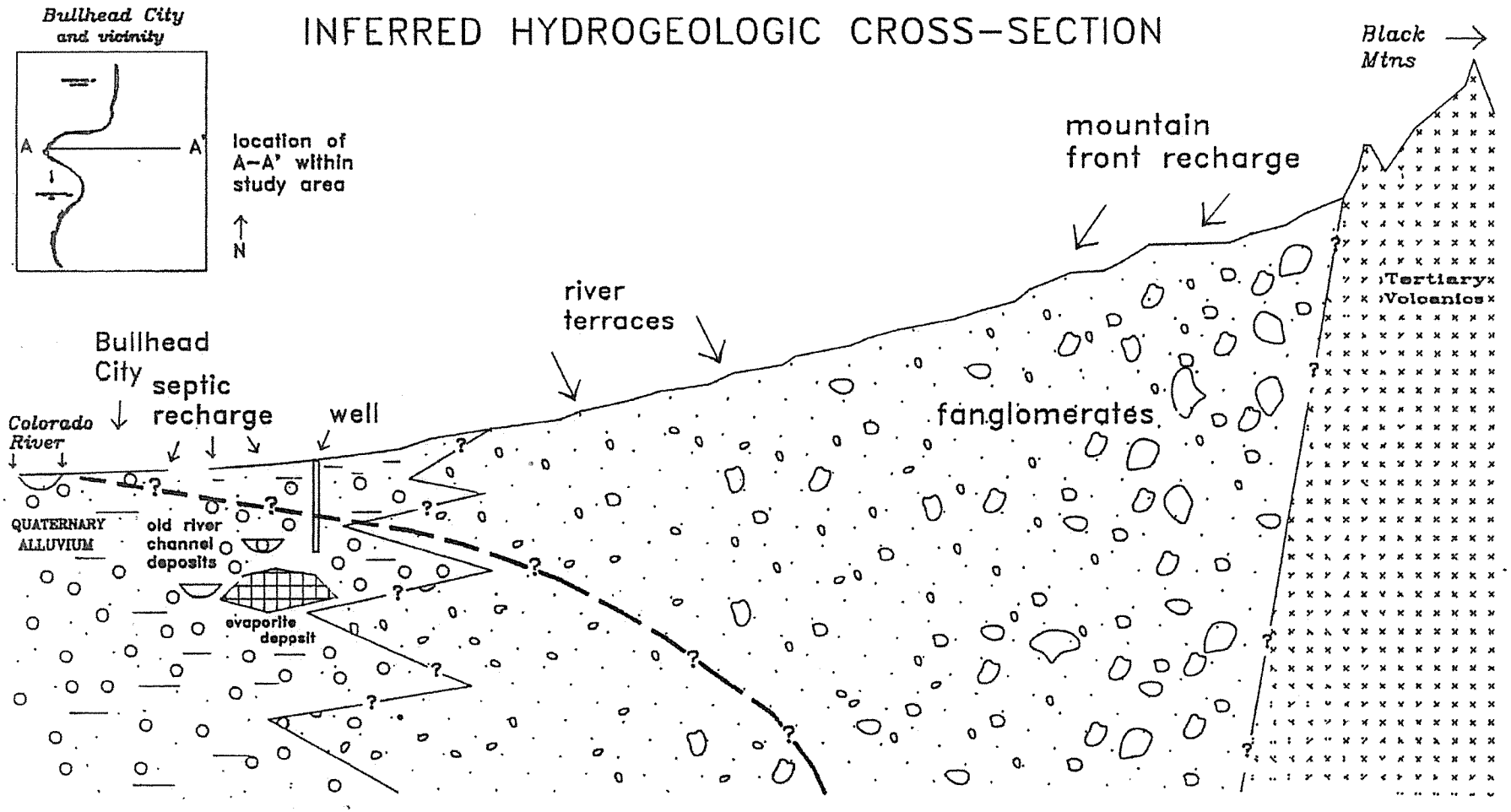
* Building permits issued in the first 5 months of 1989 is double the total amount issued the previous year. Due to the construction of additional casinos in Laughlin, rapid growth is expected to continue in the near future.

HYDROGEOLOGY

The Colorado River is the dominant surface hydrologic feature and bounds the western part of the study area. Davis Dam impounds the River five miles to the north forming Lake Mohave. The fairly narrow river bed incises the alluvial flood plain and is enclosed by mountain ranges to the east and west. Lithology is divisible into three broad categories: riverbed alluvium, fanglomerates, and crystalline rocks. The primary aquifer is the riverbed alluvium of Quaternary (?) age (Metzger and Loeltz, 1973). The depositional environment is a meandering river bed, with a typical stratigraphy of gravel, sand, silt and mud. The mountain-forming units are mid to late Tertiary volcanic and igneous rocks, but it is unlikely that these units are water bearing in the study area. Along the mountain fronts are the fanglomerates formed by the erosion of the mountain-forming units. The fanglomerates are composed of angular poorly sorted pebbles cemented in a sandy matrix (figure 3). A few wells located further east from the river and away from the riverbed alluvium probably withdraw water from the fanglomerate unit.

Depth to groundwater in wells measured in this study ranges from 30 feet near the river to 183 feet one and a quarter miles away from the river. This data is compiled in table 2 along with other well information. An equipotential map was prepared from this

figure 3


INFERRED HYDROGEOLOGIC CROSS-SECTION
Bullhead City and vicinity
A
A'
location of A–A' within study area
N
Black Mtns
mountain front recharge
river terraces
Bullhead City
septic recharge
well
Colorado River
fanglomerates
Tertiary Volcanics
QUATERNARY ALLUVIUM
old river channel deposits
evaporite deposit

data and is presented in figure 4. The water elevation data was inconsistent and could not be contoured. Therefore, a groundwater flow direction for the area could not be determined. Inconsistent water elevation data could result from changing river stages, differences in total depth and perforated interval of the wells measured, and local pumping of wells.

However, the most likely groundwater flow direction is to the south-southwest along the axis of the Colorado River with a localized component of flow to the east-southeast away from the axis of the river. The data supports the premise that the aquifer is being recharged by the Colorado River because in most cases the elevation of the river is higher than groundwater elevation.

RESULTS OF GROUNDWATER QUALITY INVESTIGATION

Groundwater samples were collected during three separate sampling events. In 1987 a field reconnaissance of groundwater quality was conducted, samples including two duplicates and one field blank were collected from twenty-two wells. An additional five samples were collected for a nitrogen isotope study in 1988. Recently in May of 1989, as part of a state wide virus study, 15 samples including one duplicate were collected. In all 36 wells were sampled. Three of these wells were sampled more than once. The Super 8 monitor well (B-20-22)01da was sampled four times once during each sampling event including one duplicate. The Riviera well (B-20-22)09dcd was sampled three times one sample and one duplicate were collected in 1987 and one sample was collected in 1988. A duplicate sample of the Tierra Verde well (AV40, AV41) was collected in 1989. The locations of these wells are shown in Figure 5 and tabulated with well I.D., cadastral location, and well owners name in Appendix I. A total of 42 samples were collected during the three sampling periods. All samples were analyzed for primary and secondary drinking water parameters. Bacteria samples were collected from 22 wells. The results of the analysis are given in Table 3.

A number of sample results in the study area are above the Primary (MCL) or Secondary (SMCL) drinking water maximum contaminant level. The two parameters detected above primary MCLs are nitrate and arsenic. Below is a summary of constituents detected at levels of concern:

- Nitrate is above background (typically 3 mg/l as N) in nine wells and exceeded the MCL (10 mg/l as N) in one well.
- Chloride exceeds the SMCL(250 mg/l) in fifteen wells,
- Total Dissolved Solids exceeds the SMCL (500 mg/l) in thirty six wells.
- Arsenic exceeds the MCL (0.05 mg/l) in three wells.

TABLE 2

T/R	SECT.	SITE NAME	SURFACE ELEV.	GW ELEV.	WELL DEPTH	DTW	WELL USE	COMMENTS
(B-20-22)	01DAD	BHC-30	645.00	533.00	450.00	112.00	DOM	DTW ?
(B-20-22)	01DAx	BHC-28	610.00	499.39	150.00	110.61	MON	
(B-20-22)	09DCD	BHC-6	540.00	513.28		26.72	DOM	
(B-20-22)	12BAA	BHC-14	600.00	489.32		110.68	IRG	
(B-20-22)	16AAB	BHC-21-1	568.30	485.65	150.00	82.65	MON	
(B-20-22)	16AAB	BHC-21-3	578.50	485.46	150.00	93.04	MON	
(B-20-22)	16AAD	BHC-21-2	587.10	483.41	150.00	103.69	MON	
(B-20-22)	16CDD	BHC-22	680.00	475.00		205.00	DOM	
(B-20-22)	16DAB	BHC-26	700.00	490.00	690.00	210.00	PUB	
(B-20-22)	16DDD	BHC-23	740.00	474.21	610.00	265.79	PUB	
(B-20-22)	19ADA	BHC-24	548.00	482.26		65.74	PUB	
(B-20-22)	26CCA	BHC-4	580.00	482.50	165.00	97.50	DOM	
(B-20-22)	26CDA	BHC-3	680.00	496.26	350.00	183.74	IRG	
(B-20-22)	29CCC	BHC-20	695.00	504.71		190.29	DOM	
(B-20-22)	29DDC	BHC-1	520.00	500.56	30.00	19.44	IRG	LOW YIELD
(B-20-23)	24ABD	BHC-27	520.00	495.00		25.00	PUB	

Surface elevations were derived from topographic map

figure 4

GROUNDWATER ELEVATIONS

BULLHEAD CITY, AZ

and vicinity

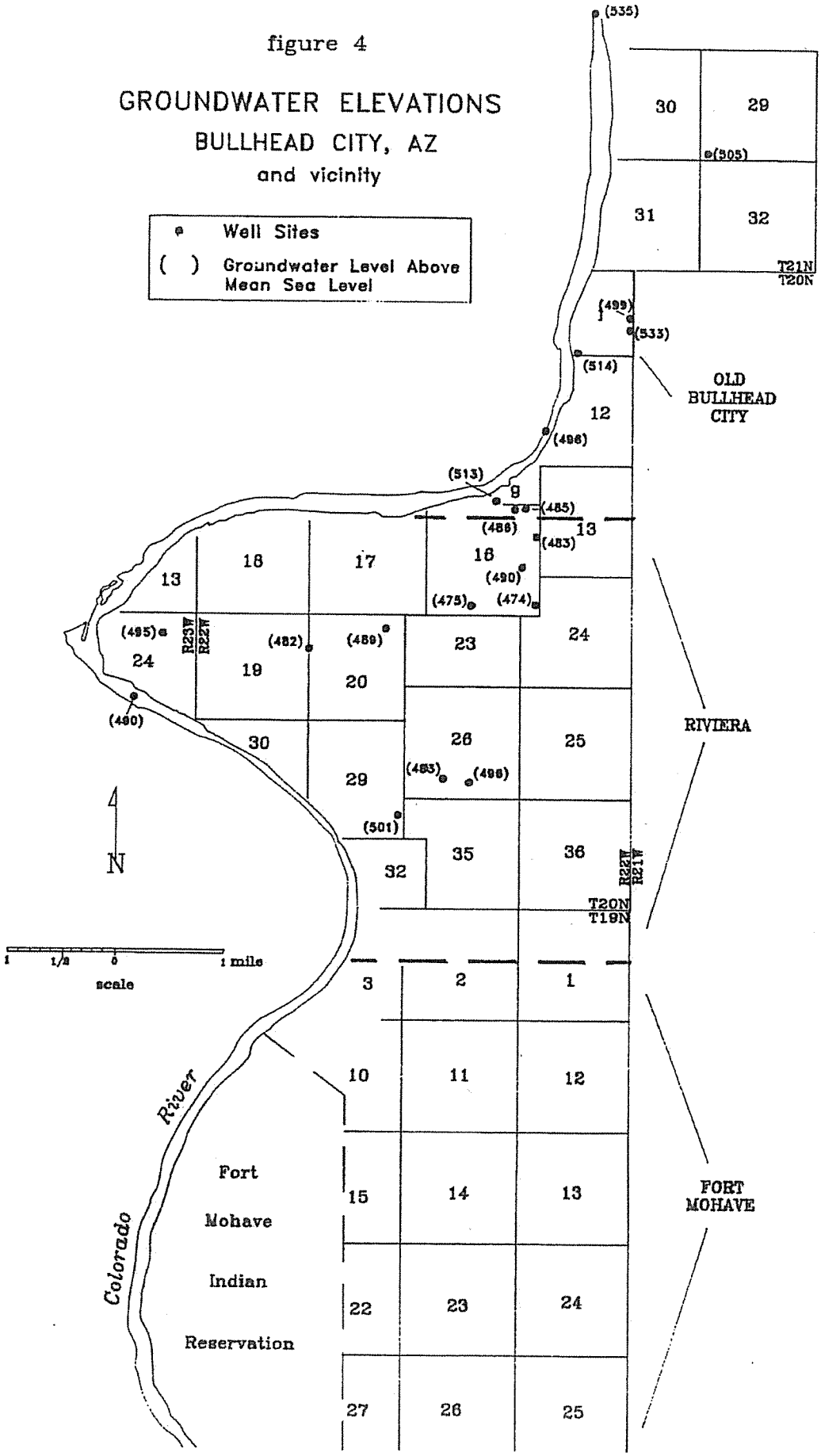


figure 5

SAMPLE POINT LOCATIONS
BULLHEAD CITY, AZ
and vicinity

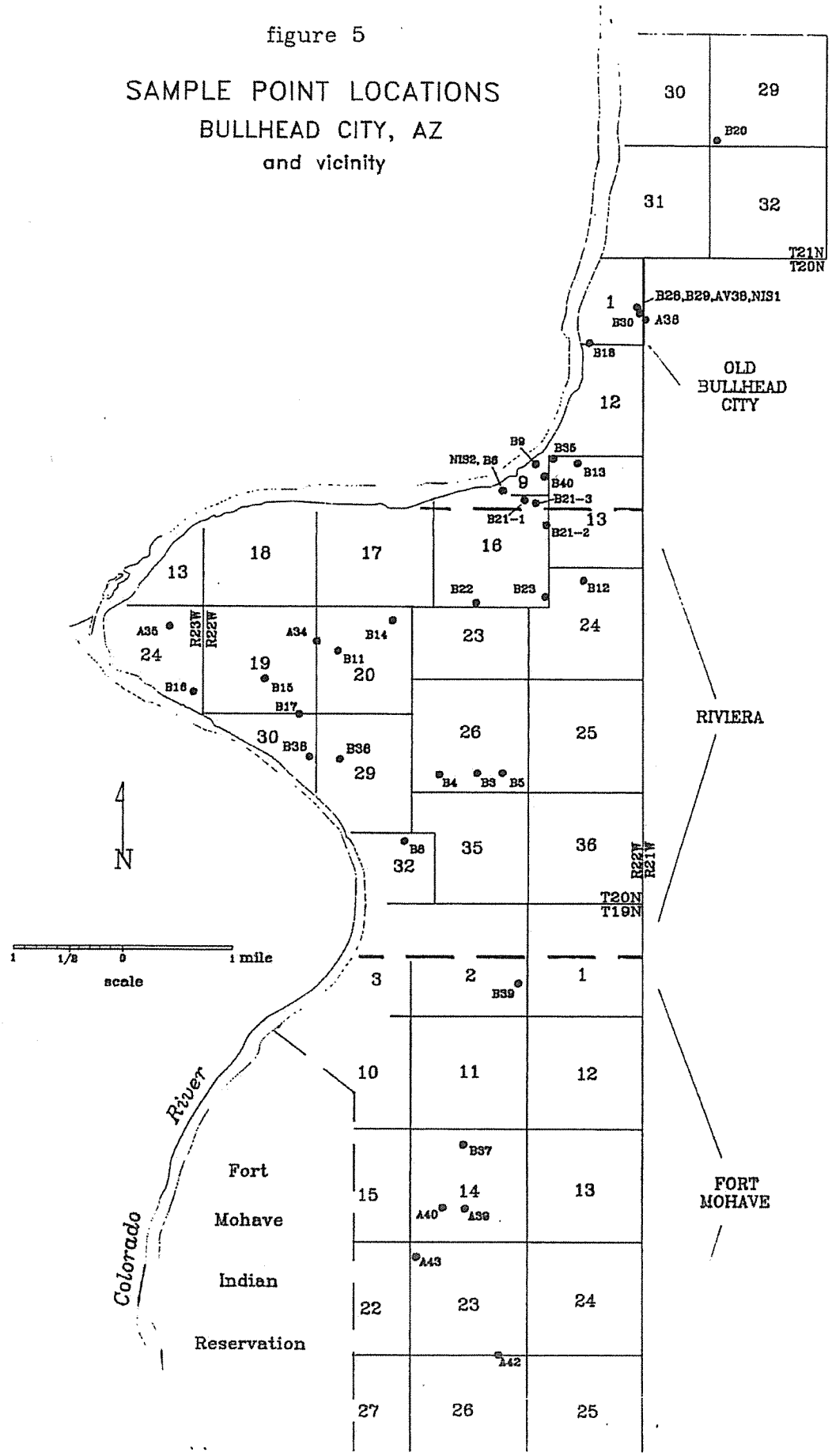


TABLE 3

Primary MCL / Secondary MCL		mg/l mg/l			0.050	1.00	0.010		250.00	0.050	1.000	4.00		0.300
Location		Sample ID	ALK.T	ALK.P	As	Ba	Cd	Ca	Cl	Cr	Cu	Fl	HARDNESS	Fe
(B-20-22)	01DAD	AV-36 89	127.00	0.00	0.000	0.06	0.000	201.00	400.00	0.000	0.011	0.27	688.000	0.126
(B-20-22)	01DAD	BHC-30 87	136.00	0.00	0.000	0.00	0.000	186.00	393.00	0.000	0.000	0.24	714.000	0.000
(B-20-22)	01DAX	AV-38 89	274.00	0.00	0.005	0.06	0.000	98.10	360.00	0.000	0.091	0.26	394.000	0.063
(B-20-22)	01DAX	BHC-28 87	188.00	0.00	0.000	0.11	0.000	174.00	408.00	0.000	0.000	0.29	765.000	0.000
(B-20-22)	01DAX	NIS-1 88	225.00	0.00	0.000	0.00	0.000	126.00	459.00	0.000	0.000	0.32	527.000	0.000
(B-20-22)	01DAX	BHC-29*87	181.00	0.00	0.000	0.00	0.000	171.00	646.00	0.000	0.000	0.30	742.000	0.000
(B-20-22)	04BAA	BHC-12 87	132.00	0.00	0.000	0.00	0.000	89.30	104.00	0.000	0.000	0.63	200.000	0.000
(B-20-22)	09DAD1	AV-37 89	141.00	0.00	0.000	0.05	0.000	82.70	65.00	0.000	0.020	0.32	305.000	0.236
(B-20-22)	09DCD	BHC-6 87	182.00	0.00	0.000	0.00	0.000	85.40	59.00	0.000	0.000	0.31	277.000	0.000
(B-20-22)	09DCD	NIS-2 88	172.00	0.00	0.000	0.00	0.000	79.80	57.00	0.000	0.000	0.32	281.000	0.260
(B-20-22)	09DCD	BHC-7*87	181.00	0.00	0.000	0.00	0.000	86.50	58.30	0.000	0.000	0.31	282.000	0.150
(B-20-22)	09DDA	BHC-40 89	187.00	0.00	0.000	0.06	0.000	102.00	110.00	0.000	0.010	0.24	375.000	0.625
(B-20-22)	09DDA	BHC-9 87	142.00	0.00	0.000	0.00	0.000	80.40	57.80	0.000	0.000	0.38	273.000	0.000
(B-20-22)	12BAA	BHC-18 87	313.00	0.00	0.000	0.00	0.000	185.00	248.00	0.000	0.000	0.30	839.000	0.000
(B-20-22)	13BBB1	BHC-35 89	278.00	0.00	0.000	0.02	0.000	142.00	170.00	0.000	0.000	0.45	547.000	0.014
(B-20-22)	13BCA	BHC-13 87	171.00	0.00	0.000	0.00	0.000	125.00	152.00	0.000	0.000	0.40	391.000	0.000
(B-20-22)	16AAB	BHC21-1 88	143.00	0.00	0.000	0.00	0.000	116.00	181.00	0.000	0.000	0.37	423.000	0.000
(B-20-22)	16AAB	BHC21-3 88	168.00	0.00	0.000	0.00	0.000	114.00	131.00	0.000	0.000	0.50	401.000	0.000
(B-20-22)	16AAD	BHC21-2 88	200.00	0.00	0.000	0.11	0.000	165.00	534.00	0.000	0.000	0.00	570.000	0.000
(B-20-22)	16CDD	BHC-22 87	174.00	0.00	0.000	0.00	0.000	151.00	245.00	0.000	0.000	0.22	541.000	0.000
(B-20-22)	16DDD	BHC-23 87	120.00	0.00	0.000	0.00	0.000	86.90	182.00	0.000	0.000	0.51	313.000	0.000
(B-20-22)	19ADA	AV-34 89	126.00	0.00	0.000	0.05	0.000	192.00	370.00	0.000	0.057	0.24	688.000	0.000
(B-20-22)	19CAD	BHC-15 87	169.00	0.00	0.000	0.00	0.000	102.00	184.00	0.000	0.000	0.32	439.000	0.000
(B-20-22)	19DDD	BHC-17 87	200.00	0.00	0.000	0.00	0.000	191.00	560.00	0.000	0.000	0.25	878.000	0.000
(B-20-22)	20ABC	BHC-14 87	154.00	2.70	0.000	0.00	0.000	98.60	163.00	0.000	0.000	0.85	362.000	0.000
(B-20-22)	20BDC	BHC-11 87	171.00	0.00	0.000	0.00	0.000	82.10	147.00	0.000	0.000	0.64	317.000	0.140
(B-20-22)	26ABD	BHC-5 87	118.00	0.00	0.099	0.00	0.000	80.70	315.00	0.000	0.000	3.84	253.000	0.000
(B-20-22)	26CCA	BHC-4 87	118.00	0.00	0.042	0.00	0.000	76.50	276.00	0.000	0.000	1.94	240.000	0.000
(B-20-22)	26CDA	BHC-3 87	115.00	0.00	0.052	0.00	0.000	87.80	332.00	0.000	0.000	2.34	264.000	0.000
(B-20-22)	29ACB	BHC-36 89	158.00	0.00	0.000	0.03	0.000	130.00	250.00	0.000	0.020	0.28	496.000	1.300
(B-20-22)	29CCC	BHC-20 87	124.00	0.00	0.000	0.00	0.000	98.30	285.00	0.000	0.000	0.48	323.000	0.100
(B-20-22)	29DDC	BHC-1#87	114.00	0.00	0.000	0.00	0.000	186.00	2260.00	0.000	0.000	5.73	766.000	0.930
(B-20-22)	29DDC	BHC-2$ 87	2.40	0.00	0.000	0.00	0.000	0.00	0.00	0.000	0.000	0.00	0.000	0.000
(B-20-22)	30ADD	BHC-38 89	181.00	0.00	0.000	0.04	0.000	139.00	120.00	0.000	0.000	0.26	516.000	0.344
(B-20-22)	32ACC	BHC-8 87	140.00	0.00	0.000	0.00	0.000	137.00	346.00	0.000	0.000	1.52	402.000	0.000
(B-20-23)	24ADA	AV-35 89	130.00	0.00	0.000	0.00	0.000	59.70	100.00	0.000	0.013	0.25	178.000	0.023
(B-20-23)	24CAB	BHC-16# 87	190.00	0.00	0.000	0.00	0.000	485.00	1120.00	0.000	0.000	0.32	2240.000	0.770
(B-19-22)	02DDD	BHC-39 89	72.00	0.00	0.010	0.00	0.000	31.20	165.00	0.000	0.024	0.52	91.600	0.564
(B-19-22)	14ABA	BHC-37 89	76.00	0.00	0.000	0.04	0.000	88.30	770.00	0.000	0.000	0.49	276.000	0.386
(B-19-22)	14CAC	AV-40 89	189.00	0.00	0.000	0.00	0.000	62.40	250.00	0.000	0.000	0.90	230.000	0.092
(B-19-22)	14CAC	AV-41*89	190.00	0.00	0.000	0.00	0.000	64.40	250.00	0.000	0.020	0.91	238.000	0.090
(B-19-22)	14DCB	AV-39 89	213.00	0.00	0.007	0.02	0.000	66.10	350.00	0.000	0.000	1.50	250.000	0.000
(B-19-22)	23BBB	AV-43 89	189.00	0.00	0.000	0.02	0.000	82.10	140.00	0.000	0.000	0.29	315.000	0.013
(B-19-22)	26ABA	AV-42 89	172.00	0.00	0.000	0.00	0.000	60.60	200.00	0.000	0.000	0.78	226.000	0.033

* denotes a sample duplicate
# denotes an unrepresentative sample due to cation/anion inbalance
$ denotes field blank
Number after sample I.D. denotes year sample was taken

TABLE 3 Continued

Primary MCL		mg/l	0.050			0.005	10.00		0.010	0.050					
Secondary MCL		mg/l			0.050						250.0		250.0	500.0	0.500
Location		Sample ID	Pb	Mg	Mn	Hg	NO3	pH	Se	Ag	Na	Sp. Con	SO4	TDS	Zn
(B-20-22)	01DAD	AV-36 89	0.000	45.10	0.014	0.000	7.65	7.70	0.000	0.000	171.0		330.0	1330.0	0.000
(B-20-22)	01DAD	BHC-30 87	0.000	46.60	0.000	0.000	8.11	7.66	0.000	0.000	177.0	5950.0	411.0	1370.0	0.000
(B-20-22)	01DAX	AV-38 89	0.017	36.10	0.000	0.000	10.70	7.80	0.000	0.000	306.0		258.0	1290.0	0.029
(B-20-22)	01DAX	BHC-28 87	0.000	61.00	0.000	0.000	15.90	7.40	0.000	0.000	319.0	2870.0	263.0	1680.0	0.000
(B-20-22)	01DAX	NIS-1 88	0.000	47.00	0.000	0.000	12.10	7.42	0.000	0.000	337.0	2410.0	268.0	1520.0	0.000
(B-20-22)	01DAX	BHC-29*87	0.000	67.00	0.000	0.000	14.40	7.36	0.000	0.000	323.0	2830.0	256.0	1690.0	0.000
(B-20-22)	04BAA	BHC-12 87	0.000	5.27	0.000	0.000	0.00	7.63	0.000	0.000	105.0	791.0	64.2	520.0	0.000
(B-20-22)	09DAD1	AV-37 89	0.002	23.90	0.689	0.000	0.00	8.00	0.000	0.000	80.4		218.0	570.0	0.014
(B-20-22)	09DCD	BHC-6 87	0.000	22.40	0.460	0.000	0.00	8.07	0.000	0.000	101.0	910.0	209.0	602.0	0.000
(B-20-22)	09DCD	NIS-2 88	0.000	19.80	0.500	0.000	0.00	7.76	0.000	0.000	116.0	900.0	219.0	630.0	
(B-20-22)	09DCD	BHC-7*87	0.000	22.50	0.450	0.000	0.00	8.08	0.000	0.000	104.0	909.0	219.0	604.0	0.000
(B-20-22)	09DDA	BHC-40 89	0.000	29.30	0.693	0.000	0.00	8.00	0.000	0.000	125.0		319.0	830.0	0.000
(B-20-22)	09DDA	BHC-9 87	0.000	24.10	0.210	0.000	0.11	7.85	0.000	0.000	101.0	854.0	260.0	552.0	0.000
(B-20-22)	12BAA	BHC-18 87	0.000	71.00	0.000	0.000	7.09	7.59	0.000	0.000	343.0	2870.0	774.0	1980.0	0.000
(B-20-22)	13BBB1	BHC-35 89	0.000	46.70	0.000	0.000	0.33	7.70	0.000	0.000	207.0		436.0	1200.0	0.000
(B-20-22)	13BCA	BHC-13 87	0.000	35.60	0.000	0.000	0.53	7.71	0.000	0.000	184.0	1470.0	360.0	1027.0	0.000
(B-20-22)	16AAB	BHC21-1 88	0.000	30.30	0.430	0.000	0.00	7.70	0.000	0.000	96.9	1360.0	239.0	823.0	0.000
(B-20-22)	16AAB	BHC21-3 88	0.000	26.90	0.540	0.000	0.00	7.65	0.000	0.000	96.9	1150.0	255.0	810.0	0.000
(B-20-22)	16AAD	BHC21-2 88	0.000	39.00	0.000	0.000	4.85	7.21	0.000	0.000	299.0	2630.0	316.0	1690.0	0.000
(B-20-22)	16CDD	BHC-22 87	0.000	33.90	0.000	0.000	3.87	7.56	0.000	0.000	152.0	1700.0	351.0	1080.0	0.000
(B-20-22)	16DDD	BHC-23 87	0.000	17.40	0.000	0.000	1.31	7.65	0.000	0.000	125.0	1210.0	235.0	733.0	0.000
(B-20-22)	19ADA	AV-34 89	0.005	50.70	0.000	0.000	5.87	7.60	0.000	0.000	200.0		424.0	1390.0	0.019
(B-20-22)	19CAD	BHC-15 87	0.000	34.20	0.050	0.000	4.60	7.77	0.000	0.000	179.0	1620.0	354.0	1046.0	0.000
(B-20-22)	19DDD	BHC-17 87	0.000	79.00	0.000	0.000	3.10	7.51	0.000	0.000	540.0	3580.0	942.0	2460.0	0.000
(B-20-22)	20ABC	BHC-14 87	0.000	25.00	0.000	0.000	1.76	8.47	0.000	0.000	128.0	1270.0	268.0	795.0	0.000
(B-20-22)	20BDC	BHC-11 87	0.000	22.90	0.000	0.000	0.24	7.88	0.000	0.000	117.0	1130.0	174.0	696.0	0.000
(B-20-22)	26ABD	BHC-5 87	0.000	11.70	0.000	0.000	1.47	7.78	0.000	0.000	197.0	1540.0	164.0	945.0	0.000
(B-20-22)	26CCA	BHC-4 87	0.000	11.00	0.000	0.000	7.92	7.74	0.000	0.000	174.0	1390.0	126.0	837.0	0.000
(B-20-22)	26CDA	BHC-3 87	0.000	12.00	0.000	0.000	0.99	7.74	0.000	0.000	198.0	1570.0	1080.0	944.0	0.000
(B-20-22)	29ACB	BHC-36 89	0.004	41.50	0.000	0.000	0.00	8.00	0.000	0.000	167.0		329.0	1040.0	0.112
(B-20-22)	29CCC	BHC-20 87	0.000	18.50	0.000	0.000	0.73	7.72	0.000	0.000	147.0	1390.0	138.0	800.0	0.000
(B-20-22)	29DDC	BHC-1#87	0.000	63.00	0.140	0.000	2.10	7.60	0.000	0.000	2010.0	8770.0	1200.0	5790.0	0.750
(B-20-22)	29DDC	BHC-2$ 87	0.000	0.00	0.000	0.000	0.00	5.39	0.000	0.000	0.0	4.0	0.0	9.0	0.000
(B-20-22)	30ADD	BHC-38 89	0.000	40.90	0.484	0.000	0.00	8.00	0.000	0.000	139.0		423.0	1040.0	0.000
(B-20-22)	32ACC	BHC-8 87	0.000	24.10	0.000	0.001	1.11	7.60	0.000	0.000	243.0	1840.0	280.0	1137.0	0.000
(B-20-23)	24ADA	AV-35 89	0.000	7.11	0.000	0.000	0.20	7.90	0.000	0.000	146.0		186.0	580.0	0.000
(B-20-23)	24CAB	BHC-16# 87	0.020	251.00	2.340	0.000	0.00	7.75	0.000	0.000	1050.0	6800.0	1760.0	5050.0	0.000
(B-19-22)	02DDD	BHC-39 89	0.004	3.33	0.019	0.000	0.52	8.20	0.000	0.000	144.0		118.0	530.0	0.067
(B-19-22)	14ABA	BHC-37 89	0.000	13.60	0.055	0.000	0.00	8.00	0.000	0.000	490.0		234.0	1650.0	0.078
(B-19-22)	14CAC	AV-40 89	0.000	18.00	0.024	0.000	1.77	8.00	0.000	0.000	261.0		273.0	990.0	0.000
(B-19-22)	14CAC	AV-41*89	0.003	18.80	0.024	0.000	1.75	8.00	0.000	0.000	268.0		273.0	980.0	0.000
(B-19-22)	14DCB	AV-39 89	0.000	20.60	0.060	0.000	0.38	8.10	0.000	0.000	347.0		344.0	1250.0	0.000
(B-19-22)	23BBB	AV-43 89	0.002	26.60	0.000	0.000	1.72	8.00	0.000	0.000	158.0		279.0	840.0	0.000
(B-19-22)	26ABA	AV-42 89	0.009	18.20	0.000	0.000	0.80	8.00	0.000	0.000	208.0		256.0	870.0	0.000

* denotes a sample duplicate
# denotes an unrepresentative sample due to cation/anion imbalance
$ denotes field blank
Number after sample I.D. denotes year sample was taken

- Iron exceeds the SMCL (0.33 mg/l) in five wells.
- Manganese exceeds the SMCL (0.05 mg/l) in ten wells.
- Sulfate exceeds the SMCL (250 mg/l) in twenty four wells .

As indicated above, every well exceeded the SMCL (500 mg/l) for total dissolved solids. Many of the wells, also exceeded other SMCL's. However, only four wells sampled exceeded an MCL. One well exceeded the MCL for nitrate (10 mg/l) and three other wells exceeded the MCL for arsenic (.05 mg/l). All other results were below primary drinking water maximum contaminant levels. Coliform bacteria were not found in any of the samples from the 22 wells for which bacteria was tested. Maps showing the wells which exceeded MCL's or SMCLs are presented in Figure 6 for nitrate, Figure 7 for Chloride, and Figure 8 for Total Dissolved Solids.

As part of a state wide virus study, 14 virus samples were taken in the study area. Although there are no water quality standards for viruses in groundwater, samples were taken to determine the prevalence of microbiological organisms in Arizona's groundwater. Laboratory analysis included waterborne enteroviruses which are harmful to humans. Virus samples taken from the study area indicated that no viral contamination was present.

A survey of 87,000 wells (Madison and Brunett, 1984) with nitrate analyses using the United States Geological Survey's National Water-Data Storage and Retrieval System (WATSTORE) of nitrate concentrations in groundwater indicates the following:

- Less than 0.2 mg/l - assumed to represent natural background concentrations.
- 0.21 to 3.0 mg/l - Transitional; concentrations that may or may not represent human influence.
- 3.1 to 10.0 mg/l - May indicate elevated concentrations resulting from human activities.
- Greater than 10 mg/l - Exceeds maximum contaminant limit.

Arsenic exceeded the MCL in three wells, all located within the same area. Although the source of the arsenic is unknown, there is no evidence of an anthropogenic source such as pesticides. Therefore, it is believed the source of arsenic is naturally occurring. There are several different natural environments with which arsenic is typically associated (Welch, Lico, Hughes, 1988). Two of these environments may be present in the study area. These environments are: 1) Sediments partially derived from volcanic rocks of intermediate acidic composition and 2) Evaporite deposits. No specific evaporite deposits have been documented in the area. However, they are known to occur in the Bouse Formation

figure 6

NITRATE LEVELS

BULLHEAD CITY, AZ
and vicinity

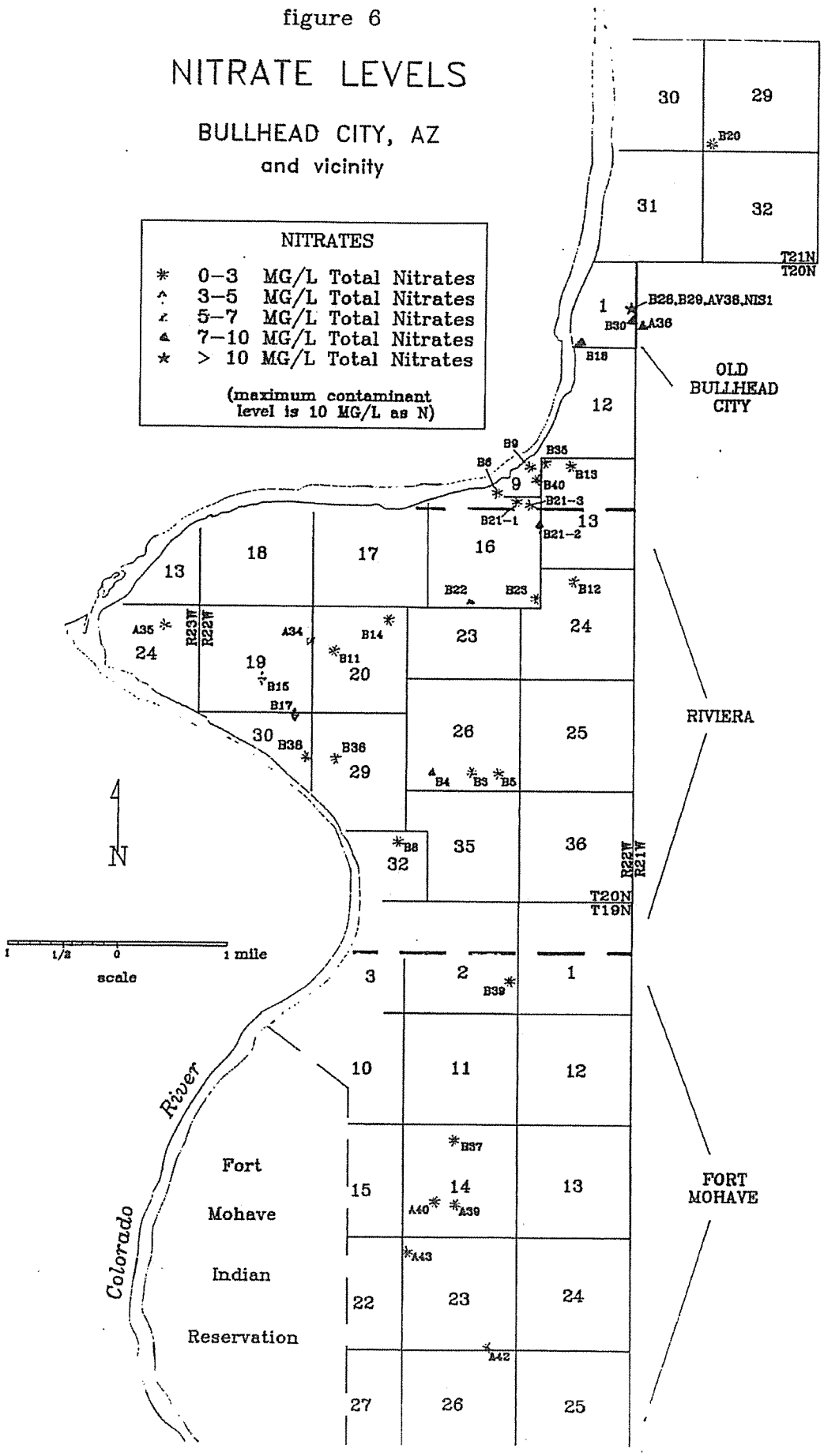


figure 7

CHLORIDE LEVELS

BULLHEAD CITY, AZ

and vicinity

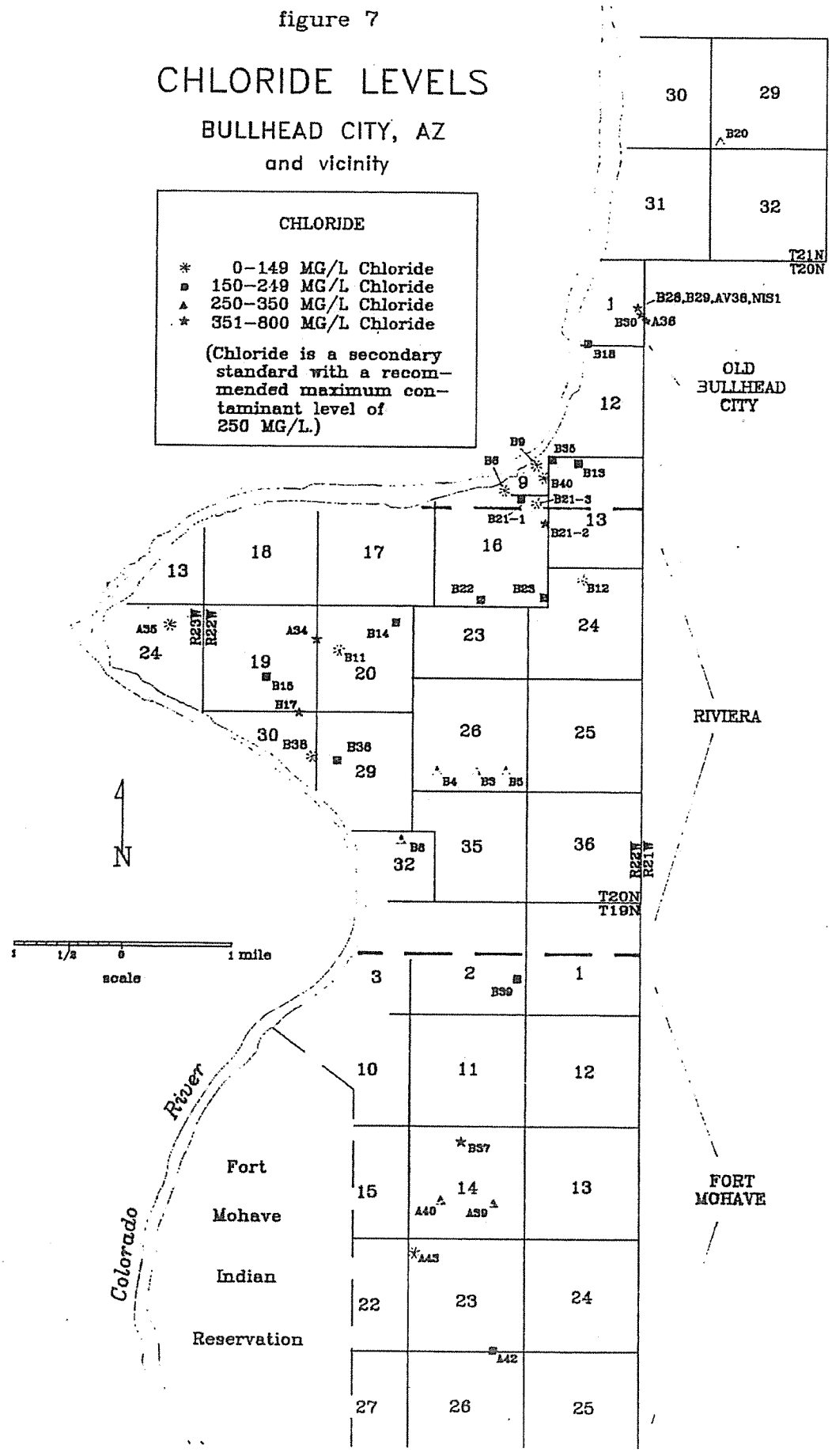


figure 8

TOTAL DISSOLVED SOLIDS

BULLHEAD CITY, AZ
and vicinity

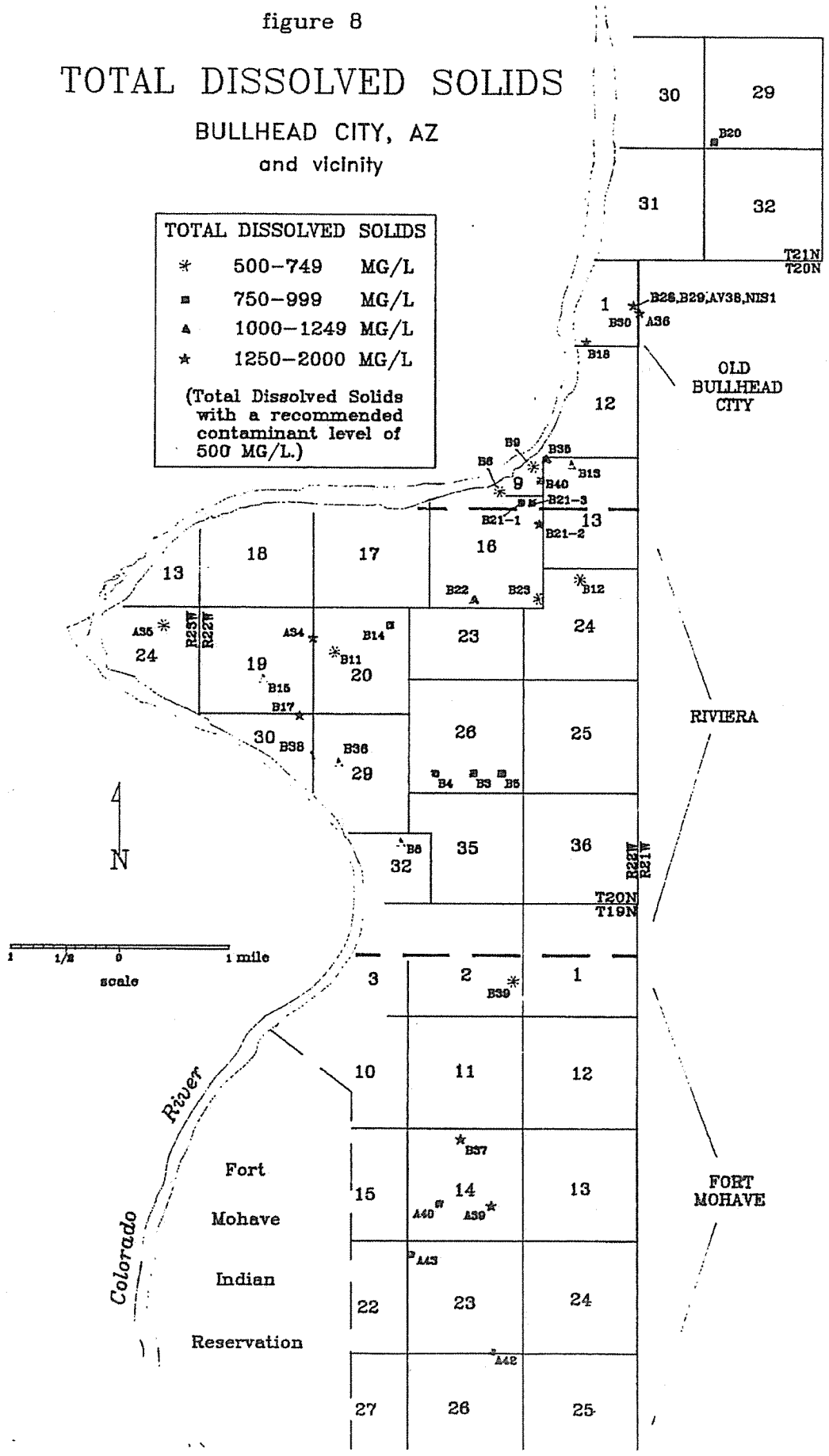
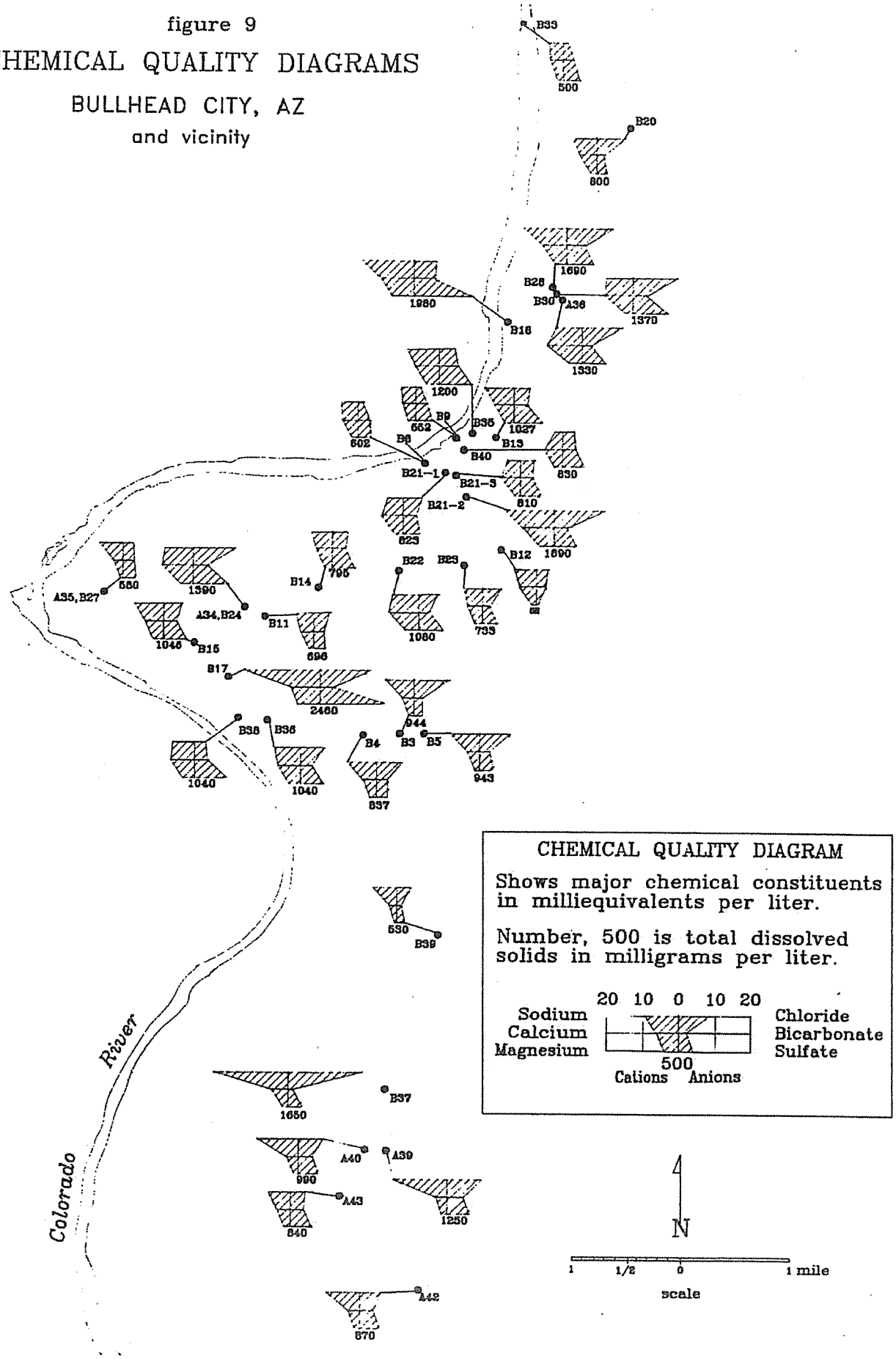


figure 9

CHEMICAL QUALITY DIAGRAMS

BULLHEAD CITY, AZ

and vicinity



south of the study area and can be expected to occur in Quaternary meandering river deposits.

INTERPRETATION OF RESULTS

We have identified three potential major influences on groundwater quality in the Bullhead City area: recharge from surface water, discharge from septic systems, and local hydrogeology. How these three important factors affect groundwater quality depends on many factors such as the location of the well, total depth of the well and the stratigraphic units penetrated, and proximity to discharging septic systems.

Surface/Groundwater Interplay

Figure 9 shows the stiff diagrams representative of water quality for the wells sampled. A surface water sample of the Colorado River (B-33) was included on figure 9 for comparative purposes. Stiff diagrams of similar shapes have ratios of concentrations of major ions though not necessarily the same chemical concentrations. Thus, these diagrams allow a qualitative assessment of groundwater geochemistry. Comparison of the stiff diagram for surface water with those of groundwater samples shows that samples B-6 and B-9 are similar to the surface water sample B33, indicating that groundwater obtained from these wells is primarily derived from the river. This similarity indicates that wells which are strongly influenced by surface water are located closest to the river. Other groundwater samples show varying degrees of deviation from surface water quality indicating that other factors, either natural (lithologic changes) or anthropogenic (domestic sewage), are influencing groundwater quality.

Wastewater Impact

Recharge from domestic sewage contains nitrates, salts, phosphates, metals, bacteria, viruses and a variety of household contaminants. The major constituent of concern is nitrate which ranges from 40 to 70 mg/l (as N) in domestic sewage or 4 to 7 times the maximum contaminant level of 10 mg/l. Nitrate is not appreciably attenuated in the vadose zone. Consequently, most nitrate from septic tank discharge will reach the aquifer. Impacts of septic effluent are generally first observed in the upper portion of the aquifer. Therefore, shallow wells will most likely exhibit high nitrates before other wells in a region. Increase of total dissolved solids (TDS) is another signature of the influence of septage. A rule of thumb is that water which passes through a septic tank experiences a TDS increase of about 100 to 300 mg/l. (Kaplan, 1987).

To assess the potential impacts of domestic sewage on groundwater quality, maps of nitrate concentrations (figure 6), chloride concentrations (figure 7), total dissolved solid concentrations

(figure 8), and stiff diagrams representing groundwater quality (figure 9) were prepared. The impact of domestic sewage on groundwater quality is shown by increases in nitrate, chloride and TDS concentrations, and by a distinct shape of the stiff diagram. To determine where the impact of domestic sewage would most likely occur, a map illustrating the distribution of sewered areas was produced and is included as figure 2. This figure shows that development in the study area are predominantly on septic systems except along the northern reach of the river bend where both Riverside Sanitary District and Citizens Utilities service areas are located. Examination of figure 2 suggests that domestic sewage recharge would probably be greatest in the Old Bullhead City and Riviera areas, since these areas have the highest density of development dependent on septic tank systems for wastewater disposal.

To characterize the shape of the stiff diagram representing groundwater affected by municipal sewage, the three monitor wells at the Sierra Wastewater Treatment Plant were examined. Monitor wells B 21-1 and B 21-3 are upgradient of the percolation ponds and show identical stiff diagram. However, the downgradient well B 21-2 illustrates an increase of nitrate, chloride, sulfate and total dissolved solids, all of which are indications of wastewater impact. The characteristic Stiff diagram shape in the downgradient monitor well is an excellent example of groundwater contamination by wastewater. A comparable signature might be expected for septic effluent. Wells exhibiting this stiff configuration were found in the old Bullhead City area (B-28, B-30, B-18, A-36) and in Riviera (A-34, B-15, B-17, B-22). All these wells contain nitrate concentrations above 3 mg/l, chloride above 180 mg/l, sulfate above 250 mg/l and TDS above 1000 mg/l. An increase of all these parameters is indicative of wastewater impact. In addition, preliminary results from the Nitrogen Isotope Study currently being conducted by ADEQ indicate that the nitrogen stable isotope ratio (N^{15}/N^{14}) at B 21-2 (Sierra Wastewater Treatment Plant) and B 28 (Super 8 Motel) represents a nitrate source from septic or wastewater effluent. The ratio was too high to indicate a synthetic source. The final results will be presented in a report entitled "The Application of Nitrogen Isotopes in Groundwater as an identifier of Nitrate Sources in Arizona" by Melanie Redding and Dave Totman.

There are three reasons why old Bullhead City is the most likely area to exhibit impacts from discharging septic systems: 1) this area has been inhabited the longest; 2) shallow groundwater (depth to water is approximately 30 feet) and 3) this area has the highest density of discharging facilities in the study area, over 5 houses per acre. Indeed, high nitrate values are found in the old Bullhead City area (B-18, B-28, B-30, A-36). Since there are a number of discharging facilities in the area, it is difficult to pinpoint specific facilities as sources of nitrate. In addition it appears that the elevated nitrate levels may extend across a

large area because all wells sampled in the area contain above 7 mg/l total nitrogen. However, to determine the extent of nitrate contamination, additional sampling in this area will be required.

Lithology and Water Quality

The local geology in the study area has not been studied in any great detail. At this time, it is difficult to assess the total impact of lithology on water quality. However, the presence of some elevated constituents, such as chlorides (Figure 7) in the southern end of the study area and arsenic (B-3, B-4, B-5) in the Riviera area might be related to geology since there is no other identifiable source. Mountain-front recharge and recharge along individual surface streams may impact individual wells.

Conclusions

Our study identified three influences on groundwater quality in the study area: recharge from the Colorado river, recharge from septic systems, and possibly local geology.

Groundwater due to recharge from the Colorado River is characterized by lower sodium and chloride levels. Groundwater quality has been affected by discharging septic systems in the old Bullhead City area and other parts of the Riviera area, as evidenced by high nitrate, elevated chlorides, sulfates and total dissolved solids. Individual wells in the southern end of the study area exhibit unique chemical signatures indicative of the influence of the local hydrogeology. It is possible that nitrate concentrations measured in groundwater as a result of septage discharges will increase due to a lag between the first appearance of high nitrates in groundwater and the equilibrium (full impact) condition.

Finally, the impact of the tremendous population growth both within and outside the 208 plan area whichare dependant on septic systems represents the most significant threat to groundwater quality in the study area.

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APPENDIX 1: SAMPLING LOCATION DATA

OWNER NAME / SAMPLE NAME	SAMPLE #	CADASTRAL LOCATION	ADWR #
Wildman	BHC-1	(B-20-22)29ddd(ddc)	500559
(duplicate of above)	BHC-2		
Richardson (Mallicoat)	BHC-3	(B-20-22)26cdb	511183
VFW (Proctor)	BHC-4	(B-20-22)26cca	
Lewis	BHC-5	(B-20-22)26dbc(abd)	501515
Riverview (Colorado River Sites)	BHC-6	(B-20-22)09dcd	
Field Blank	BHC-7		
Palo Verde Development	BHC-8	(B-20-22)32acc(abb)	
El Rio	BHC-9	(B-20-22)09dad(dda)	617209
BHC Elementary School #1	BHC-10	(B-20-22)20bdb	
BHC Elementary School #2	BHC-11	(B-20-22)20bdc	501451
Silver Creek (Kline)	BHC-12	(B-20-22)24baa	504082
KOA Campground (MacDonald)	BHC-13	(B-20-22)13bca	602919
Mohave High School (BHC)	BHC-14	(B-20-22)20 (abc)	649175
Southwick (Grasse)	BHC-15	(B-20-22)19cad	500945
Thompson	BHC-16	(B-20-23)24dad(cab)	502201
Little	BHC-17	(B-20-22)19ddd	602230
Goad	BHC-18	(B-20-22)12baa	607020
Mohave High School	BHC-19	(B-20-22)20aac	649175
Citizens Utility (MH-291)	BHC-20	(B-21-21)29ccc	
Sierra WWTP Monitor well 1	BHC-21-1	(B-20-22)16aab	
Sierra WWTP Monitor well 2	BHC-21-2	(B-20-22)16aad	
Sierra WWTP Monitor well 3	BHC-21-3	(B-20-22)16aab	
Citizens Utility 16-1	BHC-22	(B-20-22)16aab	
Citizens Utility 16-2	BHC-23	(B-20-22)16ddd	603472
Citizens Utility	BHC-24	(B-20-22)19ada	
Citizens Utility 24-1	BHC-25	(B-20-22)24ddd(dba)	
Citizens Utility 16-3	BHC-26	(B-20-22)16dab(dab)	509446
Riverbend #2	BHC-27	(B-20-23)24abd	
Super-8	BHC-28	(B-20-22)01da	512175
(duplicate of above)	BHC-29		
Carefree Resort	BHC-30	(B-20-22)01dad	632760
Field Blank	BHC-31		
BHC Elementary School	BHC-32	(B-20-22)01dbc	
Riverbend #1	BHC-34	(B-20-23)24dbb	
Rainbow Haven	BHC-35	(B-20-22)13bbb1	
Bojorquez Ranch	BHC-36	(B-20-22)29acb	
Snager	BHC-37	(B-19-22)14aba	623375
Mohave County Parks	BHC-38	(B-20-22)30bdb	
Mohave County Community College	BHC-39	(B-19-22)02dda	
Moore	BHC-40	(B-20-22)09dda	
Citizens Utility - Riviera	AV-34	(B-20-22)19ada	
Citizens Utility - Riverbend #2	AV-35	(B-20-23)24ada	
Citizens Utility - Bullhead #4	AV-36	(B-20-22)01dad	
El Rio Motel	AV-37	(B-20-22)09dad1	
Super 8	AV-38	(B-20-22)01da	617209
Brown	AV-39	(B-20-22)14dcb	507751
Bermuda Water - Tierra Verde	AV-40	(B-19-22)14cca	600336
(duplicate of above)	AV-41		
Bermuda Water - Las Estancias	AV-42	(B-19-22)26aba	600335
Bermuda Water - Rainbow Acres	AV-43	(B-19-22)23bbb	600337

Cadastral location in parentheses is the actual well location

Appendix D

CATION-ANION BALANCE EQUATIONS

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-01
Site ID:			Samp Date:	6/6/94
Lab ID:	E94-4176		Samp Time:	13:05

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	180

2. Calculate Concentration:

Hydroxide		OH=	-61.2
Carbonate		CO3=	0
Bicarbonate		HCO3=	219.6

3. Calculate (meq/l)

CATIONS	Lab Conce'n (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	75	3.74	24.93
MAGNESIUM (Mg++)	26	2.14	14.24
SODIUM (Na+)	210	9.13	60.82
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab Conce'n (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	219.6	3.60	22.00
CHLORIDE (Cl-)	230	6.49	39.65
SULFATE (SO4-)	290	6.04	36.90
NITRATE (as N)	3.1	0.22	1.35
FLUORIDE	0.34	0.02	0.11
		tot.ani%=	100

TOTAL CATIONS=	15.01	%Diff=	-4.31	%
TOTAL ANIONS=	16.36			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+- 0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P - T)
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P)

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-02
Site ID:			Samp Date:	6/6/94
Lab ID:	E94-4177		Samp Time:	14:21

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	110

2. Calculate Concentration:

Hydroxide		OH=	-37.4
Carbonate		CO3=	0
Bicarbonate		HCO3=	134.2

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	14	0.70	19.53
MAGNESIUM (Mg++)	1.7	0.14	3.91
SODIUM (Na+)	63	2.74	76.56
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	134.2	2.20	61.53
CHLORIDE (Cl-)	5	0.14	3.95
SULFATE (SO4-)	40	0.83	23.30
NITRATE (as N)	5.25	0.37	10.48
FLUORIDE	0.51	0.03	0.75
		tot.ani%=	100

TOTAL CATIONS=	3.58	%Diff=	0.03	%
TOTAL ANIONS=	3.58			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -, set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-04
Site ID:			Samp Date:	6/6/94
Lab ID:	E94-4179		Samp Time:	15:38

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	150

2. Calculate Concentration:

Hydroxide		OH=	-51
Carbonate		CO3=	0
Bicarbonate		HCO3=	183

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	77	3.84	38.39
MAGNESIUM (Mg++)	29	2.38	23.83
SODIUM (Na+)	87	3.78	37.79
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	183	3.00	28.07
CHLORIDE (Cl-)	72	2.03	19.01
SULFATE (SO4-)	270	5.62	52.61
NITRATE (as N)	0.24	0.02	0.16
FLUORIDE	0.29	0.02	0.14
		tot.ani%=	100

TOTAL CATIONS=	10.01	%Diff=	-3.26	%
TOTAL ANIONS=	10.68			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-05
Site ID:			Samp Date:	6/7/94
Lab ID:	E94-4186		Samp Time:	08:42

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	190

2. Calculate Concentration:

Hydroxide	OH=	-64.6
Carbonate	CO3=	0
Bicarbonate	HCO3=	231.8

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	190	9.48	39.27
MAGNESIUM (Mg++)	62	5.10	21.12
SODIUM (Na+)	220	9.57	39.62
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	231.8	3.80	15.28
CHLORIDE (Cl-)	410	11.57	46.51
SULFATE (SO4-)	420	8.74	35.16
NITRATE (as N)	10.5	0.75	3.01
FLUORIDE	0.18	0.01	0.04
		tot.ani%=	100

TOTAL CATIONS=	24.14	%Diff=	-1.48	%
TOTAL ANIONS=	24.87			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-06
Site ID:			Samp Date:	6/7/94
Lab ID:	E94-4186		Samp Time:	10:25

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	180

2. Calculate Concentration:

Hydroxide		OH=	-61.2
Carbonate		CO3=	0
Bicarbonate		HCO3=	219.6

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	91	4.54	44.69
MAGNESIUM (Mg++)	25	2.06	20.23
SODIUM (Na+)	82	3.57	35.08
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	219.6	3.60	33.60
CHLORIDE (Cl-)	110	3.10	28.96
SULFATE (SO4-)	190	3.96	36.93
NITRATE (as N)	0.443	0.03	0.30
FLUORIDE	0.44	0.02	0.22
		tot.ani%=	100

TOTAL CATIONS=	10.16	%Diff=	-2.64	%
TOTAL ANIONS=	10.71			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-08
Site ID:			Samp Date:	6/7/94
Lab ID:	E94-4174		Samp Time:	14:15

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	270

2. Calculate Concentration:

Hydroxide		OH=	-91.8
Carbonate		CO3=	0
Bicarbonate		HCO3=	329.4

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	140	6.99	25.96
MAGNESIUM (Mg++)	52	4.28	15.89
SODIUM (Na+)	360	15.65	58.16
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	329.4	5.40	18.87
CHLORIDE (Cl-)	540	15.23	53.25
SULFATE (SO4-)	380	7.91	27.66
NITRATE (as N)	0.519	0.04	0.13
FLUORIDE	0.48	0.03	0.09
		tot.ani%=	100

TOTAL CATIONS=	26.91	%ERROR=	-3.05	%
TOTAL ANIONS=	28.61			

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-09
Site ID:			Samp Date:	6/7/94
Lab ID:	E94-4180		Samp Time:	10:09

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	110

2. Calculate Concentration:

Hydroxide		OH=	-37.4
Carbonate		CO3=	0
Bicarbonate		HCO3=	134.2

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	66	3.29	38.80
MAGNESIUM (Mg++)	5	0.41	4.84
SODIUM (Na+)	110	4.78	56.35
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	134.2	2.20	24.80
CHLORIDE (Cl-)	150	4.23	47.71
SULFATE (SO4-)	110	2.29	25.82
NITRATE (as N)	1.33	0.09	1.07
FLUORIDE	1	0.05	0.59
		tot.ani%=	100

TOTAL CATIONS=	8.49	%ERROR=	-2.20	%
TOTAL ANIONS=	8.87			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-10
Site ID:			Samp Date:	6/7/94
Lab ID:	E94-4181		Samp Time:	11:03

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	200

2. Calculate Concentration:

Hydroxide		OH=	-68
Carbonate		CO3=	0
Bicarbonate		HCO3=	244

3. Calculate (meq/l)

CATIONS	CONCE'N (mg/l)	meq/l	% tot.
CALCIUM (Ca++)	98	4.89	34.02
MAGNESIUM (Mg++)	36	2.96	20.60
SODIUM (Na+)	150	6.52	45.38
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	CONCE'N (mg/l)	meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	244	4.00	25.53
CHLORIDE (Cl-)	140	3.95	25.21
SULFATE (SO4-)	370	7.70	49.17
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.26	0.01	0.09
		tot.ani%=	100

TOTAL CATIONS=	14.37	%Diff=	-4.31	%
TOTAL ANIONS=	15.67			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

		Samp ID:	MV694-11
Site ID:		Samp Date:	6/7/94
Lab ID:	E94-4181	Samp Time:	15:25

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	230

2. Calculate Concentration:

Hydroxide	OH=	-78.2
Carbonate	CO3=	0
Bicarbonate	HCO3=	280.6

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	180	8.98	26.67
MAGNESIUM (Mg++)	73	6.00	17.82
SODIUM (Na+)	430	18.70	55.51
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	280.6	4.60	13.04
CHLORIDE (Cl-)	810	22.85	64.80
SULFATE (SO4-)	350	7.29	20.67
NITRATE (as N)	7.2	0.51	1.46
FLUORIDE	0.23	0.01	0.03
		tot.ani%=	100

TOTAL CATIONS=	33.68	%Diff=	-2.29	%
TOTAL ANIONS=	35.26			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-12
Site ID:			Samp Date:	6/8/94
Lab ID:	E94-4253		Samp Time:	09:30

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	180

2. Calculate Concentration:

Hydroxide	OH=	-61.2
Carbonate	CO3=	0
Bicarbonate	HCO3=	219.6

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	220	10.98	32.81
MAGNESIUM (Mg++)	83	6.83	20.40
SODIUM (Na+)	360	15.65	46.78
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	219.6	3.60	10.15
CHLORIDE (Cl-)	760	21.44	60.47
SULFATE (SO4-)	500	10.41	29.36
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.14	0.01	0.02
		tot.ani%=	100

TOTAL CATIONS=	33.46	%Diff=	-2.90	%
TOTAL ANIONS=	35.46			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-13
Site ID:			Samp Date:	6/7/94
Lab ID:	E94-4182		Samp Time:	13:38

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	120

2. Calculate Concentration:

Hydroxide		OH=	-40.8
Carbonate		CO3=	0
Bicarbonate		HCO3=	146.4

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	79	3.94	30.91
MAGNESIUM (Mg++)	12	0.99	7.74
SODIUM (Na+)	180	7.83	61.36
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	146.4	2.40	17.89
CHLORIDE (Cl-)	280	7.90	58.87
SULFATE (SO4-)	120	2.50	18.62
NITRATE (as N)	7.5	0.54	3.99
FLUORIDE	1.6	0.08	0.63
		tot.ani%=	100

TOTAL CATIONS=	12.76	%Diff=	-2.53	%
TOTAL ANIONS=	13.42			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-14
Site ID:			Samp Date:	6/7/94
Lab ID:	E94-4183		Samp Time:	14:35

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	180

2. Calculate Concentration:

Hydroxide		OH=	-61.2
Carbonate		CO3=	0
Bicarbonate		HCO3=	219.6

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	90	4.49	28.39
MAGNESIUM (Mg++)	32	2.63	16.64
SODIUM (Na+)	200	8.70	54.97
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	219.6	3.60	21.63
CHLORIDE (Cl-)	180	5.08	30.51
SULFATE (SO4-)	370	7.70	46.29
NITRATE (as N)	3.54	0.25	1.52
FLUORIDE	0.18	0.01	0.06
		tot.ani%=	100

TOTAL CATIONS=	15.82	%Diff=	-2.54	%
TOTAL ANIONS=	16.64			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P -3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: E94-4184

Samp ID: MV694-15
Samp Date: 6/7/94
Samp Time: 14:36

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	180

2. Calculate Concentration:

Hydroxide	OH=	-61.2
Carbonate	CO3=	0
Bicarbonate	HCO3=	219.6

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	92	4.59	28.84
MAGNESIUM (Mg++)	32	2.63	16.53
SODIUM (Na+)	200	8.70	54.63
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	219.6	3.60	21.11
CHLORIDE (Cl-)	180	5.08	29.78
SULFATE (SO4-)	390	8.12	47.62
NITRATE (as N)	3.42	0.24	1.43
FLUORIDE	0.18	0.01	0.06
		tot.ani%=	100

TOTAL CATIONS=	15.92	%Diff=	-3.43	%
TOTAL ANIONS=	17.05			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P -3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: E94-4185

Samp ID: MV694-16
Samp Date: 6/7/94
Samp Time: 15:44

1. Alkalinity Data:

Alk P (pH=8.3) P= 0
Alk MP, MO (pH=4.5) T= 240

2. Calculate Concentration:

Hydroxide OH= -81.6
Carbonate CO3= 0
Bicarbonate HCO3= 292.8

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	310	15.47	30.89
MAGNESIUM (Mg++)	130	10.69	21.35
SODIUM (Na+)	550	23.91	47.76
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	292.8	4.80	10.03
CHLORIDE (Cl-)	690	19.46	40.67
SULFATE (SO4-)	1100	22.90	47.85
NITRATE (as N)	9.63	0.69	1.44
FLUORIDE	0.17	0.01	0.02
		tot.ani%=	100

TOTAL CATIONS= 50.07 %Diff= 2.26 %
TOTAL ANIONS= 47.86

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T)
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P)

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Well/Owner Name:	Needles Bridge	Samp ID:	MV694-17
Site ID:		Samp Date:	6/8/94
Lab ID:	E94-4254	Samp Time:	10:40

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	130

2. Calculate Concentration:

Hydroxide	OH=	-44.2
Carbonate	CO3=	0
Bicarbonate	HCO3=	158.6

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	78	3.89	33.93
MAGNESIUM (Mg++)	34	2.80	24.38
SODIUM (Na+)	110	4.78	41.69
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	158.6	2.60	22.11
CHLORIDE (Cl-)	94	2.65	22.55
SULFATE (SO4-)	310	6.45	54.89
NITRATE (as N)	0.519	0.04	0.32
FLUORIDE	0.29	0.02	0.13
		tot.ani%=	100

TOTAL CATIONS=	11.47	%Diff=	-1.24 %
TOTAL ANIONS=	11.76		

%Difference = (sum cations - sum anions)/(sum cations - sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide =0.34(2P-T) if -,set to 0
Carbonate = 1.20P -3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Well/Owner Name:	Laughlin Bridge	Samp ID:	MV694-18
Site ID:		Samp Date:	6/8/94
Lab ID:	E94-4255	Samp Time:	15:20

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	140

2. Calculate Concentration:

Hydroxide	OH=	-47.6
Carbonate	CO3=	0
Bicarbonate	HCO3=	170.8

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	77	3.84	33.89
MAGNESIUM (Mg++)	33	2.71	23.93
SODIUM (Na+)	110	4.78	42.18
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	170.8	2.80	23.31
CHLORIDE (Cl-)	89	2.51	20.90
SULFATE (SO4-)	320	6.66	55.47
NITRATE (as N)	0.304	0.02	0.18
FLUORIDE	0.31	0.02	0.14
		tot.ani%=	100

TOTAL CATIONS=	11.34	%Diff=	-2.88	%
TOTAL ANIONS=	12.01			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P)

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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		Samp ID:	MV694-19
Site ID:		Samp Date:	6/9/94
Lab ID:	E94-4256	Samp Time:	07:37

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	210

2. Calculate Concentration:

Hydroxide	OH=	-71.4
Carbonate	CO3=	0
Bicarbonate	HCO3=	256.2

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	130	6.49	44.23
MAGNESIUM (Mg++)	36	2.96	20.19
SODIUM (Na+)	120	5.22	35.58
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	256.2	4.20	21.55
CHLORIDE (Cl-)	320	9.03	46.33
SULFATE (SO4-)	300	6.25	32.06
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.21	0.01	0.06
		tot.ani%=	100

TOTAL CATIONS=	14.66	%Diff=	-14.11	%
TOTAL ANIONS=	19.48			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P -3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-21
Site ID:			Samp Date:	6/9/94
Lab ID:	E94-4258		Samp Time:	09:08

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	240

2. Calculate Concentration:

Hydroxide	OH=	-81.6
Carbonate	CO3=	0
Bicarbonate	HCO3=	292.8

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	180	8.98	38.17
MAGNESIUM (Mg++)	50	4.11	17.48
SODIUM (Na+)	240	10.43	44.35
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	292.8	4.80	18.86
CHLORIDE (Cl-)	200	5.64	22.17
SULFATE (SO4-)	720	14.99	58.92
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.2	0.01	0.04
		tot.ani%=	100

TOTAL CATIONS=	23.53	%Diff=	-3.91	%
TOTAL ANIONS=	25.44			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -, set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-22
Site ID:			Samp Date:	6/9/94
Lab ID:	E94-4259		Samp Time:	09:10

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	240

2. Calculate Concentration:

Hydroxide		OH=	-81.6
Carbonate		CO3=	0
Bicarbonate		HCO3=	292.8

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	170	8.48	36.97
MAGNESIUM (Mg++)	49	4.03	17.56
SODIUM (Na+)	240	10.43	45.47
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	292.8	4.80	19.28
CHLORIDE (Cl-)	180	5.08	20.40
SULFATE (SO4-)	720	14.99	60.22
NITRATE (as N)	0.19	0.01	0.05
FLUORIDE	0.21	0.01	0.04
		tot.ani%=	100

TOTAL CATIONS=	22.95	%Diff=	-4.06	%
TOTAL ANIONS=	24.89			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: E94-4261

Samp ID: MV694-24
Samp Date: 6/9/94
Samp Time: 10:35

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	220

2. Calculate Concentration:

Hydroxide	OH=	-74.8
Carbonate	CO3=	0
Bicarbonate	HCO3=	268.4

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	160	7.98	38.55
MAGNESIUM (Mg++)	49	4.03	19.46
SODIUM (Na+)	200	8.70	41.99
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	268.4	4.40	21.02
CHLORIDE (Cl-)	290	8.18	39.08
SULFATE (SO4-)	400	8.33	39.79
NITRATE (as N)	0.19	0.01	0.06
FLUORIDE	0.21	0.01	0.05
		tot.ani%=	100

TOTAL CATIONS= 20.71 %Diff= -0.54 %
TOTAL ANIONS= 20.93

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-25
Site ID:			Samp Date:	6/13/94
Lab ID:	38237		Samp Time:	14:28

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	149

2. Calculate Concentration:

Hydroxide		OH=	-50.66
Carbonate		CO3=	0
Bicarbonate		HCO3=	181.78

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	93.3	4.66	39.18
MAGNESIUM (Mg++)	27.6	2.27	19.10
SODIUM (Na+)	114	4.96	41.71
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	181.78	2.98	25.79
CHLORIDE (Cl-)	107	3.02	26.13
SULFATE (SO4-)	265	5.52	47.76
NITRATE (as N)	0.2	0.01	0.12
FLUORIDE	0.45	0.02	0.21
		tot.ani%=	100

TOTAL CATIONS=	11.88	%Diff=	1.40	%
TOTAL ANIONS=	11.55			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-27
Site ID:			Samp Date:	6/13/94
Lab ID:	38241		Samp Time:	15:10

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	140

2. Calculate Concentration:

Hydroxide	OH=	-47.6
Carbonate	CO3=	0
Bicarbonate	HCO3=	170.8

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	103	5.14	35.31
MAGNESIUM (Mg++)	24.1	1.98	13.62
SODIUM (Na+)	171	7.43	51.08
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	170.8	2.80	19.35
CHLORIDE (Cl-)	192	5.42	37.43
SULFATE (SO4-)	296	6.16	42.59
NITRATE (as N)	0.69	0.05	0.34
FLUORIDE	0.78	0.04	0.28
		tot.ani%=	100

TOTAL CATIONS=	14.56	%Diff=	0.30	%
TOTAL ANIONS=	14.47			

%Difference = (sum cations - sum anions)/(sum cation + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if-,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-28
Site ID:			Samp Date:	6/13/94
Lab ID:	38239		Samp Time:	16:20

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	140

2. Calculate Concentration:

Hydroxide		OH=	-47.6
Carbonate		CO3=	0
Bicarbonate		HCO3=	170.8

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	91.5	4.57	43.34
MAGNESIUM (Mg++)	23.1	1.90	18.03
SODIUM (Na+)	93.6	4.07	38.63
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	170.8	2.80	27.24
CHLORIDE (Cl-)	82.2	2.32	22.56
SULFATE (SO4-)	247	5.14	50.04
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.31	0.02	0.16
		tot.ani%=	100

TOTAL CATIONS=	10.54	%Diff=	1.24	%
TOTAL ANIONS=	10.28			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 38251

Samp ID: MV694-30
Samp Date: 6/14/94
Samp Time: 07:44

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	112

2. Calculate Concentration:

Hydroxide	OH=	-38.08
Carbonate	CO3=	0
Bicarbonate	HCO3=	136.64

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	18.4	0.92	8.79
MAGNESIUM (Mg++)	1.6	0.13	1.26
SODIUM (Na+)	216	9.39	89.95
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	136.64	2.24	21.13
CHLORIDE (Cl-)	217	6.12	57.74
SULFATE (SO4-)	74.4	1.55	14.61
NITRATE (as N)	7.12	0.51	4.79
FLUORIDE	3.48	0.18	1.73
		tot.ani%=	100

TOTAL CATIONS=	10.44	%Diff=	-0.76 %
TOTAL ANIONS=	10.60		

%Difference = (sum cations - sum anion)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -, set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-31
Site ID:			Samp Date:	6/14/94
Lab ID:	38253		Samp Time:	08:17

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	114

2. Calculate Concentration:

Hydroxide	OH=	-38.76
Carbonate	CO3=	0
Bicarbonate	HCO3=	139.08

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	116	5.79	39.68
MAGNESIUM (Mg++)	21.9	1.80	12.34
SODIUM (Na+)	161	7.00	47.98
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100
ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	139.08	2.28	15.50
CHLORIDE (Cl-)	342	9.65	65.58
SULFATE (SO4-)	131	2.73	18.54
NITRATE (as N)	0.45	0.03	0.22
FLUORIDE	0.45	0.02	0.16
		tot.ani%=	100

TOTAL CATIONS=	14.59	%Diff=	-0.41	%
TOTAL ANIONS=	14.71			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 38253

Samp ID: MV694-32
Samp Date: 6/14/94
Samp Time: 08:33

1. Alkalinity Data:

Alk P (pH=8.3) P= 0
Alk MP, MO (pH=4.5) T= 111

2. Calculate Concentration:

Hydroxide OH= -37.74
Carbonate CO3= 0
Bicarbonate HCO3= 135.42

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	126	6.29	35.78
MAGNESIUM (Mg++)	20.9	1.72	9.78
SODIUM (Na+)	220	9.57	54.44
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	135.42	2.22	12.94
CHLORIDE (Cl-)	421	11.88	69.21
SULFATE (SO4-)	135	2.81	16.38
NITRATE (as N)	3.21	0.23	1.34
FLUORIDE	0.43	0.02	0.13
		tot.ani%=	100

TOTAL CATIONS= 17.57 %Diff= 1.19 %
TOTAL ANIONS= 17.16

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/l)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-33
Site ID:			Samp Date:	6/14/94
Lab ID:	38354		Samp Time:	08:55

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	81.8

2. Calculate Concentration:

Hydroxide		OH=	-27.812
Carbonate		CO3=	0
Bicarbonate		HCO3=	99.796

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	86.7	4.33	26.36
MAGNESIUM (Mg++)	16.4	1.35	8.22
SODIUM (Na+)	247	10.74	65.43
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	99.796	1.64	27.66
CHLORIDE (Cl-)	38.2	1.08	18.22
SULFATE (SO4-)	133	2.77	46.82
NITRATE (as N)	4.79	0.34	5.78
FLUORIDE	1.71	0.09	1.52
		tot.ani%=	100

TOTAL CATIONS=	16.41	%Diff=	47.02	%
TOTAL ANIONS=	5.91			

%Difference = (sum cations - sum anions)/(sumcations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxie)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkali

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 38256

Samp ID: MV694-34
Samp Date: 6/14/94
Samp Time: 09:20

1. Alkalinity Data:

Alk P (pH=8.3) P= 0
Alk MP, MO (pH=4.5) T= 128

2. Calculate Concentration:

Hydroxide OH= -43.52
Carbonate CO3= 0
Bicarbonate HCO3= 156.16

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	13.1	0.65	13.27
MAGNESIUM (Mg++)	1	0.08	1.67
SODIUM (Na+)	96.4	4.19	85.06
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	156.16	2.56	54.83
CHLORIDE (Cl-)	28.5	0.80	17.22
SULFATE (SO4-)	35.6	0.74	15.88
NITRATE (as N)	5.08	0.36	7.77
FLUORIDE	3.81	0.20	4.30
		tot.ani%=	100

TOTAL CATIONS= 4.93 %Diff= 2.70 %
TOTAL ANIONS= 4.67

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-35
Site ID:			Samp Date:	6/14/94
Lab ID:	38242		Samp Time:	09:25

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	126

2. Calculate Concentration:

Hydroxide		OH=	-42.84
Carbonate		CO3=	0
Bicarbonate		HCO3=	153.72

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	12.3	0.61	12.61
MAGNESIUM (Mg++)	1	0.08	1.69
SODIUM (Na+)	95.9	4.17	85.70
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	153.72	2.52	54.51
CHLORIDE (Cl-)	28.5	0.80	17.39
SULFATE (SO4-)	36	0.75	16.22
NITRATE (as N)	5.07	0.36	7.83
FLUORIDE	3.56	0.19	4.05
		tot.ani%=	100

TOTAL CATIONS=	4.87	%Diff=	2.56	%
TOTAL ANIONS=	4.62			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 38243

Samp ID: MV694-36
Samp Date: 6/14/94
Samp Time: 09:48

1. Alkalinity Data:

Alk P (pH=8.3) P= 0
Alk MP, MO (pH=4.5) T= 127

2. Calculate Concentration:

Hydroxide OH= -43.18
Carbonate CO3= 0
Bicarbonate HCO3= 154.94

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	20.3	1.01	22.60
MAGNESIUM (Mg++)	1	0.08	1.83
SODIUM (Na+)	77.9	3.39	75.57
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	154.94	2.54	60.71
CHLORIDE (Cl-)	17.3	0.49	11.67
SULFATE (SO4-)	28.6	0.60	14.23
NITRATE (as N)	5.34	0.38	9.11
FLUORIDE	3.4	0.18	4.28
		tot.ani%=	100

TOTAL CATIONS= 4.48 %Diff= 3.45 %
TOTAL ANIONS= 4.18

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-37
Site ID:			Samp Date:	6/14/94
Lab ID:	38244		Samp Time:	11:37

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	483

2. Calculate Concentration:

Hydroxide		OH=	-164.22
Carbonate		CO3=	0
Bicarbonate		HCO3=	589.26

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	873	43.56	27.57
MAGNESIUM (Mg++)	295	24.26	15.35
SODIUM (Na+)	2074	90.17	57.07
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	589.26	9.66	5.76
CHLORIDE (Cl-)	4080	115.09	68.65
SULFATE (SO4-)	2060	42.89	25.58
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.22	0.01	0.01
		tot.ani%=	100

TOTAL CATIONS=	158.00	%Diff=	-2.96	%
TOTAL ANIONS=	167.65			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -, set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Samp ID: MV694-38
Samp Date: 6/14/94
Samp Time: 13:55

Site ID:
Lab ID: 38245

1. Alkalinity Data:

Alk P (pH=8.3) P= 0
Alk MP, MO (pH=4.5) T= 257

2. Calculate Concentration:

Hydroxide OH= -87.38
Carbonate CO3= 0
Bicarbonate HCO3= 313.54

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	176	8.78	39.06
MAGNESIUM (Mg++)	55.6	4.57	20.33
SODIUM (Na+)	210	9.13	40.61
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	313.54	5.14	22.35
CHLORIDE (Cl-)	199	5.61	24.41
SULFATE (SO4-)	587	12.22	53.15
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.37	0.02	0.08
		tot.ani%=	100

TOTAL CATIONS= 22.49 %Diff= -1.12 %
TOTAL ANIONS= 22.99

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

		Samp ID:	MV694-39
Site ID:		Samp Date:	6/14/94
Lab ID:	38246	Samp Time:	14:51

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	270

2. Calculate Concentration:

Hydroxide	OH=	-91.8
Carbonate	CO3=	0
Bicarbonate	HCO3=	329.4

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	210	10.48	36.07
MAGNESIUM (Mg++)	56.7	4.66	16.05
SODIUM (Na+)	320	13.91	47.89
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	329.4	5.40	18.76
CHLORIDE (Cl-)	423	11.93	41.46
SULFATE (SO4-)	549	11.43	39.72
NITRATE (as N)	0.1	0.01	0.02
FLUORIDE	0.22	0.01	0.04
		tot.ani%=	100

TOTAL CATIONS=	29.05	%Diff=	0.47	%
TOTAL ANIONS=	28.78			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 38247

Samp ID: MV694-40
Samp Date: 6/14/94
Samp Time: 15:30

1. Alkalinity Data:

Alk P (pH=8.3) P= 0
Alk MP, MO (pH=4.5) T= 162

2. Calculate Concentration:

Hydroxide OH= -55.08
Carbonate CO3= 0
Bicarbonate HCO3= 197.64

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	99.8	4.98	33.83
MAGNESIUM (Mg++)	29.1	2.39	16.26
SODIUM (Na+)	169	7.35	49.91
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	197.64	3.24	22.20
CHLORIDE (Cl-)	285	8.04	55.11
SULFATE (SO4-)	159	3.31	22.69
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0	0.00	0.00
		tot.ani%=	100

TOTAL CATIONS= 14.72 %Diff= 0.45 %
TOTAL ANIONS= 14.59

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkali

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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		Samp ID:	MV694-42
Site ID:		Samp Date:	6/14/94
Lab ID:	38240	Samp Time:	16:55

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	144

2. Calculate Concentration:

Hydroxide	OH=	-48.96
Carbonate	CO3=	0
Bicarbonate	HCO3=	175.68

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	94.5	4.72	43.02
MAGNESIUM (Mg++)	23.4	1.92	17.56
SODIUM (Na+)	99.4	4.32	39.43
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	175.68	2.88	24.92
CHLORIDE (Cl-)	84.1	2.37	20.53
SULFATE (SO4-)	302	6.29	54.43
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.25	0.01	0.11
		tot.ani%=	100

TOTAL CATIONS=	10.96	%Diff=	-2.63	%
TOTAL ANIONS=	11.55			

%Difference = (sum cations - sum anions)/(sum catons + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carboonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 38250

Samp ID: MV694-43
Samp Date: 6/15/94
Samp Time: 08:20

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	124

2. Calculate Concentration:

Hydroxide	OH=	-42.16
Carbonate	CO3=	0
Bicarbonate	HCO3=	151.28

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	108	5.39	31.74
MAGNESIUM (Mg++)	18.8	1.55	9.11
SODIUM (Na+)	231	10.04	59.15
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	151.28	2.48	14.23
CHLORIDE (Cl-)	359	10.13	58.13
SULFATE (SO4-)	223	4.64	26.65
NITRATE (as N)	0.95	0.07	0.39
FLUORIDE	1.97	0.10	0.60
		tot.ani%=	100

TOTAL CATIONS= 16.98 %Diff= -1.29 %
TOTAL ANIONS= 17.42

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P)

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

		Samp ID:	MV694-44
Site ID:		Samp Date:	6/15/94
Lab ID:	38249	Samp Time:	08:14

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	123

2. Calculate Concentration:

Hydroxide	OH=	-41.82
Carbonate	CO3=	0
Bicarbonate	HCO3=	150.06

3. Calculate (meq/l)

CATIONS	CONCE'N (mg/l)	meq/l	% tot.
CALCIUM (Ca++)	108	5.39	31.99
MAGNESIUM (Mg++)	18.8	1.55	9.18
SODIUM (Na+)	228	9.91	58.84
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	CONCE'N (mg/l)	meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	150.06	2.46	14.45
CHLORIDE (Cl-)	362	10.21	59.99
SULFATE (SO4-)	201	4.18	24.59
NITRATE (as N)	0.96	0.07	0.40
FLUORIDE	1.83	0.10	0.57
		tot.ani%=	100

TOTAL CATIONS=	16.85	%Diff=	-0.51	%
TOTAL ANIONS=	17.02			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Samp ID: MV694-45
Site ID: Samp Date: 6/15/94
Lab ID: 38235 Samp Time: 09:30

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	362

2. Calculate Concentration:

Hydroxide	OH=	-123.08
Carbonate	CO3=	0
Bicarbonate	HCO3=	441.64

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	365	18.21	37.34
MAGNESIUM (Mg++)	110	9.05	18.54
SODIUM (Na+)	495	21.52	44.12
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	441.64	7.24	15.47
CHLORIDE (Cl-)	624	17.60	37.63
SULFATE (SO4-)	1050	21.86	46.73
NITRATE (as N)	0.96	0.07	0.15
FLUORIDE	0.2	0.01	0.02
		tot.ani%=	100

TOTAL CATIONS= 48.78 %Diff= 2.09 %
TOTAL ANIONS= 46.78

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Samp ID: MV694-46
Samp Date: 6/15/94
Site ID:
Lab ID: 38236
Samp Time: 10:15

1. Alkalinity Data:

Alk P (pH=8.3) P= 0
Alk MP, MO (pH=4.5) T= 235

2. Calculate Concentration:

Hydroxide OH= -79.9
Carbonate CO3= 0
Bicarbonate HCO3= 286.7

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	82.7	4.13	22.27
MAGNESIUM (Mg++)	29.2	2.40	12.96
SODIUM (Na+)	276	12.00	64.77
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	286.7	4.70	24.86
CHLORIDE (Cl-)	324	9.14	48.36
SULFATE (SO4-)	242	5.04	26.66
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.45	0.02	0.13
		tot.ani%=	100

TOTAL CATIONS= 18.53 %Diff= -1.00 %
TOTAL ANIONS= 18.90

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 38304

Samp ID: MV694-48
Samp Date: 6/15/94
Samp Time: 14:14

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	161

2. Calculate Concentration:

Hydroxide	OH=	-54.74
Carbonate	CO3=	0
Bicarbonate	HCO3=	196.42

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	80.6	4.02	25.75
MAGNESIUM (Mg++)	24.2	1.99	12.74
SODIUM (Na+)	221	9.61	61.51
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	196.42	3.22	21.29
CHLORIDE (Cl-)	179	5.05	33.39
SULFATE (SO4-)	309	6.43	42.55
NITRATE (as N)	5.53	0.39	2.61
FLUORIDE	0.44	0.02	0.15
		tot.ani%=	100

TOTAL CATIONS=	15.62	%Diff=	1.63	%
TOTAL ANIONS=	15.12			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-49
Site ID:			Samp Date:	6/15/94
Lab ID:	38305		Samp Time:	15:34

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	192

2. Calculate Concentration:

Hydroxide		OH=	-65.28
Carbonate		CO3=	0
Bicarbonate		HCO3=	234.24

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	113	5.64	35.84
MAGNESIUM (Mg++)	31.3	2.57	16.36
SODIUM (Na+)	173	7.52	47.80
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	234.24	3.84	26.06
CHLORIDE (Cl-)	140	3.95	26.81
SULFATE (SO4-)	328	6.83	46.35
NITRATE (as N)	1.42	0.10	0.69
FLUORIDE	0.25	0.01	0.09
		tot.ani%=	100

TOTAL CATIONS=	15.73	%Diff=	3.29	%
TOTAL ANIONS=	14.73			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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Site ID:
Lab ID: 38307

Samp ID: MV694-51
Samp Date: 6/16/94
Samp Time: 08:33

1. Alkalinity Data:

Alk P (pH=8.3) P= 0
Alk MP, MO (pH=4.5) T= 349

2. Calculate Concentration:

Hydroxide OH= -118.66
Carbonate CO3= 0
Bicarbonate HCO3= 425.78

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	183	9.13	27.50
MAGNESIUM (Mg++)	74.9	6.16	18.55
SODIUM (Na+)	412	17.91	53.95
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	425.78	6.98	21.51
CHLORIDE (Cl-)	387	10.92	33.64
SULFATE (SO4-)	649	13.51	41.64
NITRATE (as N)	14.4	1.03	3.17
FLUORIDE	0.3	0.02	0.05
		tot.ani%=	100

TOTAL CATIONS= 33.20 %Diff= 1.15 %
TOTAL ANIONS= 32.45

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/l
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-53
Site ID:			Samp Date:	6/16/94
Lab ID:	38309		Samp Time:	09:55

1. Alkalinity Data:

	Alk P (pH=8.3)	P=	0
	Alk MP, MO (pH=4.5)	T=	325

2. Calculate Concentration:

	Hydroxide	OH=	-110.5
	Carbonate	CO3=	0
	Bicarbonate	HCO3=	396.5

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	171	8.53	44.50
MAGNESIUM (Mg++)	45.9	3.77	19.68
SODIUM (Na+)	158	6.87	35.82
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	396.5	6.50	37.81
CHLORIDE (Cl-)	165	4.65	27.08
SULFATE (SO4-)	289	6.02	35.00
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.37	0.02	0.11
		tot.ani%=	100

TOTAL CATIONS=	19.18	%Diff=	5.46	%
TOTAL ANIONS=	17.19			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

		Samp ID:	MV694-54
Site ID:		Samp Date:	6/27/94
Lab ID:	38475	Samp Time:	07:54

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	309

2. Calculate Concentration:

Hydroxide		OH=	-105.06
Carbonate		CO3=	0
Bicarbonate		HCO3=	376.98

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	279	13.92	46.44
MAGNESIUM (Mg++)	72.6	5.97	19.91
SODIUM (Na+)	232	10.09	33.65
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	376.98	6.18	20.71
CHLORIDE (Cl-)	320	9.03	30.26
SULFATE (SO4-)	702	14.62	48.99
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.23	0.01	0.04
		tot.ani%=	100

TOTAL CATIONS=	29.98	%Diff=	0.24	%
TOTAL ANIONS=	29.83			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-55
Site ID:			Samp Date:	6/27/94
Lab ID:	38476		Samp Time:	08:19

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	291

2. Calculate Concentration:

Hydroxide		OH=	-98.94
Carbonate		CO3=	0
Bicarbonate		HCO3=	355.02

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	184	9.18	38.92
MAGNESIUM (Mg++)	51.5	4.24	17.95
SODIUM (Na+)	234	10.17	43.13
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	355.02	5.82	25.91
CHLORIDE (Cl-)	216	6.09	27.13
SULFATE (SO4-)	506	10.54	46.90
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.27	0.01	0.06
		tot.ani%=	100

TOTAL CATIONS=	23.59	%Diff=	2.45	%
TOTAL ANIONS=	22.46			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-56
Site ID:			Samp Date:	6/27/94
Lab ID:	38477		Samp Time:	08:45

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	192

2. Calculate Concentration:

Hydroxide		OH=	-65.28
Carbonate		CO3=	0
Bicarbonate		HCO3=	234.24

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	122	6.09	46.35
MAGNESIUM (Mg++)	29.1	2.39	18.22
SODIUM (Na+)	107	4.65	35.42
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	234.24	3.84	29.10
CHLORIDE (Cl-)	171	4.82	36.56
SULFATE (SO4-)	217	4.52	34.25
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.23	0.01	0.09
		tot.ani%=	100

TOTAL CATIONS=	13.13	%Diff=	-0.23	%
TOTAL ANIONS=	13.19			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-57
Site ID:			Samp Date:	6/27/94
Lab ID:	38478		Samp Time:	09:30

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	222

2. Calculate Concentration:

Hydroxide	OH=	-75.48
Carbonate	CO3=	0
Bicarbonate	HCO3=	270.84

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	179	8.93	44.32
MAGNESIUM (Mg++)	45.5	3.74	18.57
SODIUM (Na+)	172	7.48	37.11
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	270.84	4.44	22.85
CHLORIDE (Cl-)	201	5.67	29.19
SULFATE (SO4-)	447	9.31	47.90
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.22	0.01	0.06
		tot.ani%=	100

TOTAL CATIONS=	20.15	%Diff=	1.83	%
TOTAL ANIONS=	19.43			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 38479

Samp ID: MV694-58
Samp Date: 6/27/94
Samp Time: 09:57

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	163

2. Calculate Concentration:

Hydroxide	OH=	-55.42
Carbonate	CO3=	0
Bicarbonate	HCO3=	198.86

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	92.8	4.63	41.06
MAGNESIUM (Mg++)	28.4	2.34	20.71
SODIUM (Na+)	99.2	4.31	38.24
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	198.86	3.26	30.37
CHLORIDE (Cl-)	89.3	2.52	23.47
SULFATE (SO4-)	237	4.93	45.98
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.36	0.02	0.18
		tot.ani%=	100

TOTAL CATIONS=	11.28	%Diff=	2.49	%
TOTAL ANIONS=	10.73			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-59
Site ID:			Samp Date:	6/27/94
Lab ID:	38478		Samp Time:	10:55

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	212

2. Calculate Concentration:

Hydroxide		OH=	-72.08
Carbonate		CO3=	0
Bicarbonate		HCO3=	258.64

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	164	8.18	44.60
MAGNESIUM (Mg++)	50.1	4.12	22.46
SODIUM (Na+)	139	6.04	32.94
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	258.64	4.24	23.20
CHLORIDE (Cl-)	255	7.19	39.36
SULFATE (SO4-)	322	6.70	36.68
NITRATE (as N)	1.78	0.13	0.70
FLUORIDE	0.23	0.01	0.07
		tot.ani%=	100

TOTAL CATIONS=	18.35	%Diff=	0.19	%
TOTAL ANIONS=	18.28			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 38474

Samp ID: MV694-61
Samp Date: 6/27/94
Samp Time: 15:10

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	153

2. Calculate Concentration:

Hydroxide	OH=	-52.02
Carbonate	CO3=	0
Bicarbonate	HCO3=	186.66

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	105	5.24	31.06
MAGNESIUM (Mg++)	10.8	0.89	5.27
SODIUM (Na+)	247	10.74	63.67
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	186.66	3.06	17.68
CHLORIDE (Cl-)	313	8.83	51.04
SULFATE (SO4-)	229	4.77	27.56
NITRATE (as N)	7.19	0.51	2.97
FLUORIDE	2.48	0.13	0.75
		tot.ani%=	100

TOTAL CATIONS=	16.87	%Diff	-1.27	%
TOTAL ANIONS=	17.30			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-62
Site ID:			Samp Date:	6/27/94
Lab ID:	38481		Samp Time:	07:47

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	355

2. Calculate Concentration:

Hydroxide		OH=	-120.7
Carbonate		CO3=	0
Bicarbonate		HCO3=	433.1

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	165	8.23	46.96
MAGNESIUM (Mg++)	47	3.87	22.04
SODIUM (Na+)	125	5.43	31.00
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	433.1	7.10	42.96
CHLORIDE (Cl-)	107	3.02	18.27
SULFATE (SO4-)	307	6.39	38.68
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.28	0.01	0.09
		tot.ani%=	100

TOTAL CATIONS=	17.53	%Diff=	2.96	%
TOTAL ANIONS=	16.52			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 38482

Samp ID: MV694-63
Samp Date: 6/27/94
Samp Time: 08:38

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	282

2. Calculate Concentration:

Hydroxide	OH=	-95.88
Carbonate	CO3=	0
Bicarbonate	HCO3=	344.04

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	301	15.02	48.56
MAGNESIUM (Mg++)	76.1	6.26	20.23
SODIUM (Na+)	222	9.65	31.21
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	344.04	5.64	19.26
CHLORIDE (Cl-)	275	7.76	26.50
SULFATE (SO4-)	762	15.87	54.20
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.2	0.01	0.04
		tot.ani%=	100

TOTAL CATIONS=	30.93	%Diff=	2.75	%
TOTAL ANIONS=	29.27			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2%
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV694-65
Site ID:			Samp Date:	6/28/94
Lab ID:	E94-4879-4881		Samp Time:	09:35

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	330

2. Calculate Concentration:

Hydroxide	OH=	-112.2
Carbonate	CO3=	0
Bicarbonate	HCO3=	402.6

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	250	12.48	26.60
MAGNESIUM (Mg++)	96	7.89	16.84
SODIUM (Na+)	610	26.52	56.56
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	402.6	6.60	14.52
CHLORIDE (Cl-)	680	19.18	42.22
SULFATE (SO4-)	940	19.57	43.08
NITRATE (as N)	0.798	0.06	0.13
FLUORIDE	0.47	0.02	0.05
		tot.ani%=	100

TOTAL CATIONS=	46.89	%Diff=	1.58	%
TOTAL ANIONS=	45.43			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 38483

Samp ID: MV694-66
Samp Date: 6/28/94
Samp Time: 09:34

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	315

2. Calculate Concentration:

Hydroxide	OH=	-107.1
Carbonate	CO3=	0
Bicarbonate	HCO3=	384.3

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	254	12.67	28.51
MAGNESIUM (Mg++)	90.4	7.43	16.72
SODIUM (Na+)	560	24.35	54.77
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	384.3	6.30	14.45
CHLORIDE (Cl-)	671	18.93	43.41
SULFATE (SO4-)	879	18.30	41.97
NITRATE (as N)	0.58	0.04	0.09
FLUORIDE	0.6	0.03	0.07
		tot.ani%=	100

TOTAL CATIONS=	44.46	%Diff=	0.97	%
TOTAL ANIONS=	43.60			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-01
Site ID:			Samp Date:	0.0040352
Lab ID:	E94-10798		Samp Time:	13:02

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	130

2. Calculate Concentration:

Hydroxide		OH=	-44.2
Carbonate		CO3=	0
Bicarbonate		HCO3=	158.6

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	88	4.39	32.00
MAGNESIUM (Mg++)	13	1.07	7.79
SODIUM (Na+)	190	8.26	60.21
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	158.6	2.60	18.30
CHLORIDE (Cl-)	320	9.03	63.53
SULFATE (SO4-)	94	1.96	13.77
NITRATE (as N)	7.5	0.54	3.77
FLUORIDE	1.7	0.09	0.63
		tot.ani%=	100

TOTAL CATIONS=	13.72	%Diff=	-1.74	%
TOTAL ANIONS=	14.21			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 41298

Samp ID: MV1294-02
Samp Date: 11/29/94
Samp Time: 13:56

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	170

2. Calculate Concentration:

Hydroxide	OH=	-57.8
Carbonate	CO3=	0
Bicarbonate	HCO3=	207.4

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	146	7.29	40.67
MAGNESIUM (Mg++)	38.3	3.15	17.58
SODIUM (Na+)	172	7.48	41.75
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	207.4	3.40	17.44
CHLORIDE (Cl-)	283	7.98	40.97
SULFATE (SO4-)	384	8.00	41.03
NITRATE (as N)	1.07	0.08	0.39
FLUORIDE	0.63	0.03	0.17
		tot.ani%=	100

TOTAL CATIONS= 17.91 %Diff= -4.21 %
TOTAL ANIONS= 19.49

%Difference = (sum cations - sum anions)/(sum cation + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if-,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-04
Site ID:			Samp Date:	11/29/94
Lab ID:	41300		Samp Time:	15:07

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	151

2. Calculate Concentration:

Hydroxide		OH=	-51.34
Carbonate		CO3=	0
Bicarbonate		HCO3=	184.22

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	97.2	4.85	40.37
MAGNESIUM (Mg++)	29.5	2.43	20.19
SODIUM (Na+)	109	4.74	39.44
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	184.22	3.02	24.43
CHLORIDE (Cl-)	108	3.05	24.65
SULFATE (SO4-)	301	6.27	50.71
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.5	0.03	0.21
		tot.ani%=	100

TOTAL CATIONS=	12.02	%Diff=	-1.41	%
TOTAL ANIONS=	12.36			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-05
Site ID:			Samp Date:	11/29/94
Lab ID:	E94-10799		Samp Time:	15:50

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	190

2. Calculate Concentration:

Hydroxide	OH=	-64.6
Carbonate	CO3=	0
Bicarbonate	HCO3=	231.8

3. Calculate (meq/l)

CATIONS	Lab Conce'n (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	84	4.19	25.54
MAGNESIUM (Mg++)	27	2.22	13.53
SODIUM (Na+)	230	10.00	60.93
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab Conce'n (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	231.8	3.80	24.35
CHLORIDE (Cl-)	210	5.92	37.96
SULFATE (SO4-)	270	5.62	36.02
NITRATE (as N)	3.4	0.24	1.56
FLUORIDE	0.34	0.02	0.11
		tot.ani%=	100

TOTAL CATIONS=	16.41	%Diff=	2.52	%
TOTAL ANIONS=	15.61			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+- 0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P - T)
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P)

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-06
Site ID:			Samp Date:	11/30/94
Lab ID:	41305		Samp Time:	08:45

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	160

2. Calculate Concentration:

Hydroxide		OH=	-54.4
Carbonate		CO3=	0
Bicarbonate		HCO3=	195.2

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	101	5.04	42.52
MAGNESIUM (Mg++)	31.5	2.59	21.86
SODIUM (Na+)	97.1	4.22	35.62
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	195.2	3.20	26.01
CHLORIDE (Cl-)	95.5	2.69	21.90
SULFATE (SO4-)	307	6.39	51.95
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.34	0.02	0.15
		tot.ani%=	100

TOTAL CATIONS=	11.85	%Diff=	-1.87	%
TOTAL ANIONS=	12.30			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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			Samp ID:	MV1294-07
Site ID:			Samp Date:	11/30/94
Lab ID:	41306		Samp Time:	09:13

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	242

2. Calculate Concentration:

Hydroxide		OH=	-82.28
Carbonate		CO3=	0
Bicarbonate		HCO3=	295.24

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	218	10.88	45.77
MAGNESIUM (Mg++)	55.2	4.54	19.10
SODIUM (Na+)	192	8.35	35.13
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	295.24	4.84	19.37
CHLORIDE (Cl-)	231	6.52	26.08
SULFATE (SO4-)	654	13.62	54.50
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.24	0.01	0.05
		tot.ani%=	100

TOTAL CATIONS=	23.77	%Diff=	-2.50	%
TOTAL ANIONS=	24.98			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-08
Site ID:			Samp Date:	11/30/94
Lab ID:	38477		Samp Time:	09:39

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	196

2. Calculate Concentration:

Hydroxide		OH=	-66.64
Carbonate		CO3=	0
Bicarbonate		HCO3=	239.12

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	138	6.89	47.18
MAGNESIUM (Mg++)	34	2.80	19.16
SODIUM (Na+)	113	4.91	33.66
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	239.12	3.92	25.89
CHLORIDE (Cl-)	184	5.19	34.28
SULFATE (SO4-)	289	6.02	39.74
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.24	0.01	0.08
		tot.ani%=	100

TOTAL CATIONS=	14.60	%Diff=	-1.83	%
TOTAL ANIONS=	15.14			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 41308

Samp ID: MV1294-09
Samp Date: 11/30/94
Samp Time: 10:13

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	283

2. Calculate Concentration:

Hydroxide	OH=	-96.22
Carbonate	CO3=	0
Bicarbonate	HCO3=	345.26

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	199	9.93	42.39
MAGNESIUM (Mg++)	55.2	4.54	19.38
SODIUM (Na+)	206	8.96	38.23
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	345.26	5.66	22.95
CHLORIDE (Cl-)	202	5.70	23.11
SULFATE (SO4-)	638	13.28	53.88
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.27	0.01	0.06
		tot.ani%=	100

TOTAL CATIONS=	23.43	%Diff=	-2.56	%
TOTAL ANIONS=	24.65			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

		Samp ID:	MV1294-10
Site ID:		Samp Date:	11/30/94
Lab ID:	41309	Samp Time:	10:39

1. Alkalinity Data:

	Alk P (pH=8.3)	P=	0
	Alk MP, MO (pH=4.5)	T=	341

2. Calculate Concentration:

	Hydroxide	OH=	-115.94
	Carbonate	CO3=	0
	Bicarbonate	HCO3=	416.02

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	349	17.42	48.09
MAGNESIUM (Mg++)	90.6	7.45	20.57
SODIUM (Na+)	261	11.35	31.34
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	416.02	6.82	18.47
CHLORIDE (Cl-)	364	10.27	27.81
SULFATE (SO4-)	952	19.82	53.69
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.22	0.01	0.03
		tot.ani%=	100

TOTAL CATIONS=	36.21	%Diff=	-0.97	%
TOTAL ANIONS=	36.92			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 41310

Samp ID: MV1294-11
Samp Date: 11/30/94
Samp Time: 11:44

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	345

2. Calculate Concentration:

Hydroxide	OH=	-117.3
Carbonate	CO3=	0
Bicarbonate	HCO3=	420.9

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	353	17.61	48.76
MAGNESIUM (Mg++)	90.8	7.47	20.67
SODIUM (Na+)	254	11.04	30.57
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	420.9	6.90	17.70
CHLORIDE (Cl-)	431	12.16	31.20
SULFATE (SO4-)	956	19.90	51.07
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.22	0.01	0.03
		tot.ani%=	100

TOTAL CATIONS=	36.13	%Diff=	-3.79	%
TOTAL ANIONS=	38.97			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 41311

Samp ID: MV1294-12
Samp Date: 11/30/94
Samp Time: 14:24

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	231

2. Calculate Concentration:

Hydroxide	OH=	-78.54
Carbonate	CO3=	0
Bicarbonate	HCO3=	281.82

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	84	4.19	23.59
MAGNESIUM (Mg++)	30.8	2.53	14.26
SODIUM (Na+)	254	11.04	62.15
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	281.82	4.62	24.06
CHLORIDE (Cl-)	324	9.14	47.61
SULFATE (SO4-)	260	5.41	28.20
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.48	0.03	0.13
		tot.ani%=	100

TOTAL CATIONS=	17.77	%Diff=	-3.87	%
TOTAL ANIONS=	19.20			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 41301

Samp ID: MV1294-13
Samp Date: 11/30/94
Samp Time: 16:38

1. Alkalinity Data:

Alk P (pH=8.3) P= 0
Alk MP, MO (pH=4.5) T= 148

2. Calculate Concentration:

Hydroxide	OH=	-50.32
Carbonate	CO3=	0
Bicarbonate	HCO3=	180.56

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	101	5.04	44.04
MAGNESIUM (Mg++)	25.8	2.12	18.54
SODIUM (Na+)	98.5	4.28	37.42
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	180.56	2.96	25.60
CHLORIDE (Cl-)	88.8	2.50	21.67
SULFATE (SO4-)	292	6.08	52.59
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.29	0.02	0.13
		tot.ani%=	100

TOTAL CATIONS= 11.44 %Diff= -0.50 %
TOTAL ANIONS= 11.56

%Difference = (sum cations - sum anions)/(sum catons + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carboonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

		Samp ID:	MV1294-15
Site ID:		Samp Date:	12/01/94
Lab ID:	E94-10800	Samp Time:	08:45

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	250

2. Calculate Concentration:

Hydroxide	OH=	-85
Carbonate	CO3=	0
Bicarbonate	HCO3=	305

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	400	19.96	32.04
MAGNESIUM (Mg++)	150	12.34	19.80
SODIUM (Na+)	690	30.00	48.16
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	305	5.00	8.56
CHLORIDE (Cl-)	690	19.46	33.31
SULFATE (SO4-)	1600	33.31	57.02
NITRATE (as N)	9.00	0.64	1.10
FLUORIDE	0.16	0.01	0.01
		tot.ani%=	100

TOTAL CATIONS=	62.30	%Diff=	3.20	%
TOTAL ANIONS=	58.43			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T)
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P)

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 41303

Samp ID: MV1294-16
Samp Date: 12/01/94
Samp Time: 9:13

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	143

2. Calculate Concentration:

Hydroxide	OH=	-48.62
Carbonate	CO3=	0
Bicarbonate	HCO3=	174.46

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	100	4.99	45.14
MAGNESIUM (Mg++)	26	2.14	19.34
SODIUM (Na+)	90.3	3.93	35.52
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	174.46	2.86	24.93
CHLORIDE (Cl-)	88.3	2.49	21.71
SULFATE (SO4-)	293	6.10	53.18
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.38	0.02	0.17
		tot.ani%=	100

TOTAL CATIONS=	11.05	%Diff=	-1.85 %
TOTAL ANIONS=	11.47		

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

		Samp ID:	MV1294-17
Site ID:		Samp Date:	12/01/94
Lab ID:	E94-10801	Samp Time:	10:03

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	200

2. Calculate Concentration:

Hydroxide	OH=	-68
Carbonate	CO3=	0
Bicarbonate	HCO3=	244

3. Calculate (meq/l)

CATIONS	CONCE'N (mg/l)	meq/l	% tot.
CALCIUM (Ca++)	150	7.49	36.74
MAGNESIUM (Mg++)	51	4.19	20.58
SODIUM (Na+)	200	8.70	42.68
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	CONCE'N (mg/l)	meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	244	4.00	21.19
CHLORIDE (Cl-)	180	5.08	26.90
SULFATE (SO4-)	470	9.79	51.84
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.24	0.01	0.07
		tot.ani%=	100

TOTAL CATIONS=	20.37	%Diff=	3.82	%
TOTAL ANIONS=	18.88			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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			Samp ID:	MV1294-19
Site ID:			Samp Date:	12/01/94
Lab ID:	E94-10803		Samp Time:	11:10

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	200

2. Calculate Concentration:

Hydroxide		OH=	-68
Carbonate		CO3=	0
Bicarbonate		HCO3=	244

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	99	4.94	29.72
MAGNESIUM (Mg++)	31	2.55	15.34
SODIUM (Na+)	210	9.13	54.94
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	244	4.00	26.41
CHLORIDE (Cl-)	140	3.95	26.08
SULFATE (SO4-)	330	6.87	45.37
NITRATE (as N)	4.40	0.31	2.07
FLUORIDE	0.18	0.01	0.06
		tot.ani%=	100

TOTAL CATIONS=	16.62	%Diff=	4.65	%
TOTAL ANIONS=	15.14			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P -3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-20
Site ID:			Samp Date:	12/01/94
Lab ID:	E94-10804		Samp Time:	13:55

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	250

2. Calculate Concentration:

Hydroxide	OH=	-85
Carbonate	CO3=	0
Bicarbonate	HCO3=	305

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	220	10.98	26.25
MAGNESIUM (Mg++)	79	6.50	15.53
SODIUM (Na+)	560	24.35	58.22
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	305	5.00	13.69
CHLORIDE (Cl-)	870	24.54	67.20
SULFATE (SO4-)	310	6.45	17.67
NITRATE (as N)	7.20	0.51	1.41
FLUORIDE	0.2	0.01	0.03
		tot.ani%=	100

TOTAL CATIONS=	41.82	%Diff=	6.77	%
TOTAL ANIONS=	36.52			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 41342

Samp ID: MV1294-23
Samp Date: 12/05/94
Samp Time: 13:48

1. Alkalinity Data:

Alk P (pH=8.3) P= 0
Alk MP, MO (pH=4.5) T= 150

2. Calculate Concentration:

Hydroxide OH= -51
Carbonate CO3= 0
Bicarbonate HCO3= 183

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	126	6.29	33.95
MAGNESIUM (Mg++)	12.9	1.06	5.73
SODIUM (Na+)	257	11.17	60.33
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	183	3.00	15.60
CHLORIDE (Cl-)	342	9.65	50.16
SULFATE (SO4-)	275	5.73	29.77
NITRATE (as N)	10.1	0.72	3.75
FLUORIDE	2.66	0.14	0.73
		tot.ani%=	100

TOTAL CATIONS= 18.52 %Diff -1.88 %
TOTAL ANIONS= 19.23

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-24
Site ID:			Samp Date:	12/05/94
Lab ID:	41343		Samp Time:	14:33

1. Alkalinity Data:

	Alk P (pH=8.3)		P=	0
	Alk MP, MO (pH=4.5)		T=	209

2. Calculate Concentration:

	Hydroxide		OH=	-71.06
	Carbonate		CO3=	0
	Bicarbonate		HCO3=	254.98

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	183	9.13	45.84
MAGNESIUM (Mg++)	57.7	4.75	23.82
SODIUM (Na+)	139	6.04	30.34
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	254.98	4.18	19.87
CHLORIDE (Cl-)	278	7.84	37.28
SULFATE (SO4-)	427	8.89	42.27
NITRATE (as N)	1.52	0.11	0.52
FLUORIDE	0.26	0.01	0.07
		tot.ani%=	100

TOTAL CATIONS=	19.92	%Diff=	-2.72	%
TOTAL ANIONS=	21.03			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 41344

Samp ID: MV1294-25
Samp Date: 12/05/94
Samp Time: 15:14

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	183

2. Calculate Concentration:

Hydroxide	OH=	-62.22
Carbonate	CO3=	0
Bicarbonate	HCO3=	223.26

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	108	5.39	37.94
MAGNESIUM (Mg++)	35.8	2.94	20.73
SODIUM (Na+)	135	5.87	41.33
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	223.26	3.66	24.91
CHLORIDE (Cl-)	184	5.19	35.33
SULFATE (SO4-)	255	5.31	36.14
NITRATE (as N)	7.23	0.52	3.51
FLUORIDE	0.32	0.02	0.11
		tot.ani%=	100

TOTAL CATIONS=	14.20	%Diff=	-1.69	%
TOTAL ANIONS=	14.69			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Penolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-27
Site ID:			Samp Date:	12/05/94
Lab ID:	41346		Samp Time:	16:52

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	180

2. Calculate Concentration:

Hydroxide	OH=	-61.2
Carbonate	CO3=	0
Bicarbonate	HCO3=	219.6

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	109	5.44	38.84
MAGNESIUM (Mg++)	31.7	2.61	18.62
SODIUM (Na+)	137	5.96	42.54
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	219.6	3.60	23.98
CHLORIDE (Cl-)	131	3.70	24.62
SULFATE (SO4-)	367	7.64	50.91
NITRATE (as N)	0.82	0.06	0.39
FLUORIDE	0.3	0.02	0.11
		tot.ani%=	100

TOTAL CATIONS=	14.00	%Diff=	-3.47	%
TOTAL ANIONS=	15.01			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: E94-11002

Samp ID: MV1294-28
Samp Date: 12/6/94
Samp Time: 08:40

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	280

2. Calculate Concentration:

Hydroxide	OH=	-95.2
Carbonate	CO3=	0
Bicarbonate	HCO3=	341.6

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	150	7.49	28.32
MAGNESIUM (Mg++)	40	3.29	12.45
SODIUM (Na+)	360	15.65	59.23
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	341.6	5.60	20.56
CHLORIDE (Cl-)	530	14.95	54.89
SULFATE (SO4-)	320	6.66	24.46
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.44	0.02	0.09
		tot.ani%=	100

TOTAL CATIONS= 26.43 %Diff= -1.51 %
TOTAL ANIONS= 27.24

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-29
Site ID:			Samp Date:	12/6/94
Lab ID:	E94-11003		Samp Time:	10:53

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	110

2. Calculate Concentration:

Hydroxide		OH=	-37.4
Carbonate		CO3=	0
Bicarbonate		HCO3=	134.2

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	95	4.74	47.05
MAGNESIUM (Mg++)	12	0.99	9.79
SODIUM (Na+)	100	4.35	43.15
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	134.2	2.20	19.00
CHLORIDE (Cl-)	220	6.21	53.60
SULFATE (SO4-)	130	2.71	23.38
NITRATE (as N)	6.05	0.43	3.73
FLUORIDE	0.66	0.03	0.30
		tot.ani%=	100

TOTAL CATIONS=	10.08	%ERROR=	-6.94	%
TOTAL ANIONS=	11.58			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 41347

Samp ID: MV1294-30
Samp Date: 12/06/94
Samp Time: 11:49

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	129

2. Calculate Concentration:

Hydroxide	OH=	-43.86
Carbonate	CO3=	0
Bicarbonate	HCO3=	157.38

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	19.6	0.98	24.09
MAGNESIUM (Mg++)	0	0.00	0.00
SODIUM (Na+)	70.9	3.08	75.91
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	157.38	2.58	59.59
CHLORIDE (Cl-)	17.8	0.50	11.60
SULFATE (SO4-)	32.2	0.67	15.49
NITRATE (as N)	5.65	0.40	9.32
FLUORIDE	3.3	0.17	4.01
		tot.ani%=	100

TOTAL CATIONS=	4.06	%Diff=	-3.20	%
TOTAL ANIONS=	4.33			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-31
Site ID:			Samp Date:	12/06/94
Lab ID:	E94-11004		Samp Time:	12:51

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	140

2. Calculate Concentration:

Hydroxide		OH=	-47.6
Carbonate		CO3=	0
Bicarbonate		HCO3=	170.8

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	20	1.00	22.54
MAGNESIUM (Mg++)	0.46	0.04	0.85
SODIUM (Na+)	78	3.39	76.60
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	170.8	2.80	59.36
CHLORIDE (Cl-)	21	0.59	12.56
SULFATE (SO4-)	34	0.71	15.01
NITRATE (as N)	6.2	0.44	9.38
FLUORIDE	3.3	0.17	3.68
		tot.ani%=	100

TOTAL CATIONS=	4.43	%Diff=	-3.16	%
TOTAL ANIONS=	4.72			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 41348

Samp ID: MV1294-32
Samp Date: 12/06/94
Samp Time: 12:07

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	133

2. Calculate Concentration:

Hydroxide	OH=	-45.22
Carbonate	CO3=	0
Bicarbonate	HCO3=	162.26

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	12.7	0.63	14.76
MAGNESIUM (Mg++)	0	0.00	0.00
SODIUM (Na+)	84.2	3.66	85.24
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	162.26	2.66	54.65
CHLORIDE (Cl-)	28.4	0.80	16.46
SULFATE (SO4-)	40	0.83	17.11
NITRATE (as N)	5.36	0.38	7.86
FLUORIDE	3.62	0.19	3.91
		tot.ani%=	100

TOTAL CATIONS=	4.29	%Diff=	-6.24 %
TOTAL ANIONS=	4.87		

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Well/Owner Name:
Site ID:
Lab ID: 41349

Samp ID: MV1294-33
Samp Date: 12/06/94
Samp Time: 12:29

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	116

2. Calculate Concentration:

Hydroxide	OH=	-39.44
Carbonate	CO3=	0
Bicarbonate	HCO3=	141.52

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	15.7	0.78	8.31
MAGNESIUM (Mg++)	1.5	0.12	1.31
SODIUM (Na+)	196	8.52	90.38
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	141.52	2.32	21.61
CHLORIDE (Cl-)	221	6.23	58.07
SULFATE (SO4-)	73.1	1.52	14.18
NITRATE (as N)	6.77	0.48	4.50
FLUORIDE	3.36	0.18	1.65
		tot.ani%=	100

TOTAL CATIONS= 9.43 %Diff= -6.48 %
TOTAL ANIONS= 10.74

%Difference = (sum cations - sum anion)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -, set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Well/Owner Name:
Site ID:
Lab ID: 41350

Samp ID: MV1294-34
Samp Date: 12/06/94
Samp Time: 12:40

1. Alkalinity Data:

Alk P (pH=8.3) P= 0
Alk MP, MO (pH=4.5) T= 122

2. Calculate Concentration:

Hydroxide OH= -41.48
Carbonate CO3= 0
Bicarbonate HCO3= 148.84

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	19.3	0.96	10.10
MAGNESIUM (Mg++)	2.2	0.18	1.90
SODIUM (Na+)	193	8.39	88.00
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	148.84	2.44	21.96
CHLORIDE (Cl-)	218	6.15	55.35
SULFATE (SO4-)	87.5	1.82	16.40
NITRATE (as N)	7.13	0.51	4.58
FLUORIDE	3.62	0.19	1.71
		tot.ani%=	100

TOTAL CATIONS= 9.54 %Diff= -7.63 %
TOTAL ANIONS= 11.11

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T = Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-35
Site ID:			Samp Date:	12/06/94
Lab ID:	41351		Samp Time:	12:55

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	115

2. Calculate Concentration:

Hydroxide		OH=	-39.1
Carbonate		CO3=	0
Bicarbonate		HCO3=	140.3

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	112	5.59	40.54
MAGNESIUM (Mg++)	23	1.89	13.72
SODIUM (Na+)	145	6.30	45.73
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	140.3	2.30	14.48
CHLORIDE (Cl-)	355	10.01	63.04
SULFATE (SO4-)	163	3.39	21.36
NITRATE (as N)	2.06	0.15	0.93
FLUORIDE	0.59	0.03	0.20
		tot.ani%=	100

TOTAL CATIONS=	13.78	%Diff=	-7.08	%
TOTAL ANIONS=	15.89			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

		Samp ID:	MV1294-36
Site ID:		Samp Date:	12/06/94
Lab ID:	41352	Samp Time:	13:08

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	114

2. Calculate Concentration:

Hydroxide	OH=	-38.76
Carbonate	CO3=	0
Bicarbonate	HCO3=	139.08

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	131	6.54	37.25
MAGNESIUM (Mg++)	22.9	1.88	10.73
SODIUM (Na+)	210	9.13	52.02
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	139.08	2.28	11.21
CHLORIDE (Cl-)	519	14.64	72.01
SULFATE (SO4-)	159	3.31	16.28
NITRATE (as N)	1.1	0.08	0.39
FLUORIDE	0.43	0.02	0.11
		tot.ani%=	100

TOTAL CATIONS=	17.55	%Diff=	-7.34	%
TOTAL ANIONS=	20.33			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/l)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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		Samp ID:	MV1294-37
Site ID:		Samp Date:	12/06/94
Lab ID:	41353	Samp Time:	13:21

1. Alkalinity Data:

	Alk P (pH=8.3)	P=	0
	Alk MP, MO (pH=4.5)	T=	94

2. Calculate Concentration:

	Hydroxide	OH=	-31.96
	Carbonate	CO3=	0
	Bicarbonate	HCO3=	114.68

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	91.5	4.57	31.25
MAGNESIUM (Mg++)	18	1.48	10.13
SODIUM (Na+)	197	8.57	58.62
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	114.68	1.88	11.56
CHLORIDE (Cl-)	381	10.75	66.07
SULFATE (SO4-)	153	3.19	19.58
NITRATE (as N)	5.49	0.39	2.41
FLUORIDE	1.19	0.06	0.39
		tot.ani%=	100

TOTAL CATIONS=	14.61	%Diff=	-5.36	%
TOTAL ANIONS=	16.27			

%Difference = (sum cations - sum anions)/(sumcations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxie)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkali

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: E94-11005

Samp ID: MV1294-38
Samp Date: 12/06/94
Samp Time: 15:14

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	180

2. Calculate Concentration:

Hydroxide	OH=	-61.2
Carbonate	CO3=	0
Bicarbonate	HCO3=	219.6

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	230	11.48	41.24
MAGNESIUM (Mg++)	72	5.92	21.27
SODIUM (Na+)	240	10.43	37.49
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	219.6	3.60	11.75
CHLORIDE (Cl-)	410	11.57	37.77
SULFATE (SO4-)	680	14.16	46.23
NITRATE (as N)	18.1	1.29	4.22
FLUORIDE	0.17	0.01	0.03
		tot.ani%=	100

TOTAL CATIONS=	27.83	%Diff=	-4.77	%
TOTAL ANIONS=	30.62			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-40
Site ID:			Samp Date:	12/06/94
Lab ID:	E94-11007		Samp Time:	17:09

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	180

2. Calculate Concentration:

Hydroxide		OH=	-61.2
Carbonate		CO3=	0
Bicarbonate		HCO3=	219.6

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	110	5.49	46.17
MAGNESIUM (Mg++)	26	2.14	17.99
SODIUM (Na+)	98	4.26	35.84
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	219.6	3.60	28.50
CHLORIDE (Cl-)	120	3.39	26.80
SULFATE (SO4-)	270	5.62	44.51
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.47	0.02	0.20
		tot.ani%=	100

TOTAL CATIONS=	11.89	%Diff=	-3.03	%
TOTAL ANIONS=	12.63			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 41354

Samp ID: MV1294-41
Samp Date: 12/06/94
Samp Time: 16:18

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	169

2. Calculate Concentration:

Hydroxide	OH=	-57.46
Carbonate	CO3=	0
Bicarbonate	HCO3=	206.18

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	110	5.49	48.12
MAGNESIUM (Mg++)	25.5	2.10	18.38
SODIUM (Na+)	87.9	3.82	33.50
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	206.18	3.38	29.30
CHLORIDE (Cl-)	124	3.50	30.33
SULFATE (SO4-)	222	4.62	40.08
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.63	0.03	0.29
		tot.ani%=	100

TOTAL CATIONS=	11.41	%Diff=	-0.54	%
TOTAL ANIONS=	11.53			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Well/Owner Name:	Needles Bridge	Samp ID:	MV1294-43
Site ID:		Samp Date:	12/07/94
Lab ID:	E94-4254	Samp Time:	10:15

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	129

2. Calculate Concentration:

Hydroxide	OH=	-43.86
Carbonate	CO3=	0
Bicarbonate	HCO3=	157.38

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	84.7	4.23	36.81
MAGNESIUM (Mg++)	32.7	2.69	23.42
SODIUM (Na+)	105	4.57	39.76
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	157.38	2.58	21.94
CHLORIDE (Cl-)	95.2	2.69	22.84
SULFATE (SO4-)	310	6.45	54.90
NITRATE (as N)	0.25	0.02	0.15
FLUORIDE	0.35	0.02	0.16
		tot.ani%=	100

TOTAL CATIONS=	11.48	%Diff=	-1.18	%
TOTAL ANIONS=	11.76			

%Difference = (sum cations - sum anions)/(sum cations - sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide =0.34(2P-T) if -,set to 0
Carbonate = 1.20P -3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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Well/Owner Name:	Laughlin Bridge	Samp ID:	MV1294-44
Site ID:		Samp Date:	12/07/94
Lab ID:	E94-4255	Samp Time:	12:30

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	128

2. Calculate Concentration:

Hydroxide	OH=	-43.52
Carbonate	CO3=	0
Bicarbonate	HCO3=	156.16

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	86.3	4.31	37.01
MAGNESIUM (Mg++)	33.1	2.72	23.39
SODIUM (Na+)	106	4.61	39.60
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	156.16	2.56	21.90
CHLORIDE (Cl-)	95	2.68	22.93
SULFATE (SO4-)	308	6.41	54.87
NITRATE (as N)	0.23	0.02	0.14
FLUORIDE	0.37	0.02	0.17
		tot.ani%=	100

TOTAL CATIONS=	11.64	%Diff=	-0.22	%
TOTAL ANIONS=	11.69			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P)

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-45
Site ID:			Samp Date:	12/07/94
Lab ID:	E94-11009		Samp Time:	15:52

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	150

2. Calculate Concentration:

Hydroxide		OH=	-51
Carbonate		CO3=	0
Bicarbonate		HCO3=	183

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	76	3.79	38.70
MAGNESIUM (Mg++)	26	2.14	21.82
SODIUM (Na+)	89	3.87	39.48
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	183	3.00	27.22
CHLORIDE (Cl-)	69	1.95	17.66
SULFATE (SO4-)	290	6.04	54.79
NITRATE (as N)	0.284	0.02	0.18
FLUORIDE	0.32	0.02	0.15
		tot.ani%=	100

TOTAL CATIONS=	9.80	%Diff=	-5.86	%
TOTAL ANIONS=	11.02			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: E94-11010

Samp ID: MV1294-46
Samp Date: 12/07/94
Samp Time: 16:30

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	110

2. Calculate Concentration:

Hydroxide	OH=	-37.4
Carbonate	CO3=	0
Bicarbonate	HCO3=	134.2

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	15	0.75	20.39
MAGNESIUM (Mg++)	1.7	0.14	3.81
SODIUM (Na+)	64	2.78	75.80
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	134.2	2.20	52.04
CHLORIDE (Cl-)	20	0.56	13.35
SULFATE (SO4-)	51	1.06	25.12
NITRATE (as N)	5.15	0.37	8.70
FLUORIDE	0.64	0.03	0.80
		tot.ani%=	100

TOTAL CATIONS= 3.67 %Diff= -7.04 %
TOTAL ANIONS= 4.23

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -, set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-47
Site ID:			Samp Date:	12/08/94
Lab ID:	E94-11011		Samp Time:	07:53

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	200

2. Calculate Concentration:

Hydroxide		OH=	-68
Carbonate		CO3=	0
Bicarbonate		HCO3=	244

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	130	6.49	43.43
MAGNESIUM (Mg++)	34	2.80	18.72
SODIUM (Na+)	130	5.65	37.84
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	244	4.00	26.34
CHLORIDE (Cl-)	160	4.51	29.72
SULFATE (SO4-)	320	6.66	43.87
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.21	0.01	0.07
		tot.ani%=	100

TOTAL CATIONS=	14.94	%Diff=	-0.83	%
TOTAL ANIONS=	15.19			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P -3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-48
Site ID:			Samp Date:	12/08/94
Lab ID:	E94-11012		Samp Time:	08:38

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	260

2. Calculate Concentration:

Hydroxide		OH=	-88.4
Carbonate		CO3=	0
Bicarbonate		HCO3=	317.2

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	200	9.98	38.39
MAGNESIUM (Mg++)	52	4.28	16.45
SODIUM (Na+)	270	11.74	45.16
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	317.2	5.20	21.02
CHLORIDE (Cl-)	220	6.21	25.08
SULFATE (SO4-)	640	13.33	53.86
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.19	0.01	0.04
		tot.ani%=	100

TOTAL CATIONS=	26.00	%Diff=	2.47	%
TOTAL ANIONS=	24.74			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -, set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

		Samp ID:	MV1294-49
Site ID:		Samp Date:	12/08/94
Lab ID:	E94-11013	Samp Time:	09:13

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	250

2. Calculate Concentration:

Hydroxide	OH=	-85
Carbonate	CO3=	0
Bicarbonate	HCO3=	305

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	260	12.97	45.12
MAGNESIUM (Mg++)	65	5.35	18.59
SODIUM (Na+)	240	10.43	36.29
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	305	5.00	18.44
CHLORIDE (Cl-)	400	11.28	41.61
SULFATE (SO4-)	520	10.83	39.92
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.16	0.01	0.03
		tot.ani%=	100

TOTAL CATIONS=	28.75	%Diff=	2.93	%
TOTAL ANIONS=	27.12			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P -3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: 41339

Samp ID: MV1294-50
Samp Date: 12/08/94
Samp Time: 09:52

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	242

2. Calculate Concentration:

Hydroxide	OH=	-82.28
Carbonate	CO3=	0
Bicarbonate	HCO3=	295.24

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	123	6.14	43.68
MAGNESIUM (Mg++)	38.6	3.17	22.59
SODIUM (Na+)	109	4.74	33.73
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	295.24	4.84	33.11
CHLORIDE (Cl-)	96.4	2.72	18.61
SULFATE (SO4-)	338	7.04	48.15
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.35	0.02	0.13
		tot.ani%=	100

TOTAL CATIONS= 14.05 %Diff= -1.96 %
TOTAL ANIONS= 14.61

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: E94-11016

Samp ID: MV1294-55
Samp Date: 12/08/94
Samp Time: 11:58

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	190

2. Calculate Concentration:

Hydroxide	OH=	-64.6
Carbonate	CO3=	0
Bicarbonate	HCO3=	231.8

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	250	12.48	32.85
MAGNESIUM (Mg++)	88	7.24	19.06
SODIUM (Na+)	420	18.26	48.09
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	231.8	3.80	10.93
CHLORIDE (Cl-)	810	22.85	65.70
SULFATE (SO4-)	390	8.12	23.35
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.14	0.01	0.02
		tot.ani%=	100

TOTAL CATIONS=	37.97	%Diff=	4.39	%
TOTAL ANIONS=	34.78			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-56
Site ID:			Samp Date:	12/08/94
Lab ID:	E94-11017		Samp Time:	12:58

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	230

2. Calculate Concentration:

Hydroxide		OH=	-78.2
Carbonate		CO3=	0
Bicarbonate		HCO3=	280.6

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	170	8.48	39.20
MAGNESIUM (Mg++)	49	4.03	18.62
SODIUM (Na+)	210	9.13	42.19
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	280.6	4.60	22.20
CHLORIDE (Cl-)	320	9.03	43.58
SULFATE (SO4-)	340	7.08	34.17
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.18	0.01	0.05
		tot.ani%=	100

TOTAL CATIONS=	21.64	%Diff=	2.19	%
TOTAL ANIONS=	20.71			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-57
Site ID:			Samp Date:	12/12/94
Lab ID:	41361		Samp Time:	13:06

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	129

2. Calculate Concentration:

Hydroxide		OH=	-43.86
Carbonate		CO3=	0
Bicarbonate		HCO3=	157.38

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	101	5.04	32.15
MAGNESIUM (Mg++)	17.8	1.46	9.34
SODIUM (Na+)	211	9.17	58.52
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	157.38	2.58	16.09
CHLORIDE (Cl-)	305	8.60	53.68
SULFATE (SO4-)	225	4.68	29.23
NITRATE (as N)	0.81	0.06	0.36
FLUORIDE	1.93	0.10	0.63
		tot.ani%=	100

TOTAL CATIONS=	15.68	%Diff=	-1.10	%
TOTAL ANIONS=	16.03			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P)

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-58
Site ID:			Samp Date:	12/12/94
Lab ID:	E94-11167		Samp Time:	15:35

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	120

2. Calculate Concentration:

Hydroxide	OH=	-40.8
Carbonate	CO3=	0
Bicarbonate	HCO3=	146.4

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	77	3.84	26.85
MAGNESIUM (Mg++)	11	0.90	6.32
SODIUM (Na+)	220	9.57	66.83
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	146.4	2.40	15.78
CHLORIDE (Cl-)	300	8.46	55.64
SULFATE (SO4-)	200	4.16	27.38
NITRATE (as N)	0.942	0.07	0.44
FLUORIDE	2.2	0.12	0.76
		tot.ani%=	100

TOTAL CATIONS=	14.31	%Diff=	-3.04	%
TOTAL ANIONS=	15.21			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P)

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-60
Site ID:			Samp Date:	12/12/94
Lab ID:	41367		Samp Time:	17:19

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	356

2. Calculate Concentration:

Hydroxide		OH=	-121.04
Carbonate		CO3=	0
Bicarbonate		HCO3=	434.32

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	235	11.73	27.73
MAGNESIUM (Mg++)	94	7.73	18.28
SODIUM (Na+)	525	22.83	53.98
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	434.32	7.12	17.12
CHLORIDE (Cl-)	541	15.26	36.70
SULFATE (SO4-)	867	18.05	43.41
NITRATE (as N)	15.9	1.13	2.73
FLUORIDE	0.28	0.01	0.04
		tot.ani%=	100

TOTAL CATIONS=	42.28	%Diff=	0.84	%
TOTAL ANIONS=	41.58			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/l
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

Site ID:
Lab ID: E94-11172

Samp ID: MV1294-61
Samp Date: 12/12/94
Samp Time: 18:25

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	120

2. Calculate Concentration:

Hydroxide	OH=	-40.8
Carbonate	CO3=	0
Bicarbonate	HCO3=	146.4

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	220	10.98	25.19
MAGNESIUM (Mg++)	95	7.81	17.93
SODIUM (Na+)	570	24.78	56.88
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	146.4	2.40	6.07
CHLORIDE (Cl-)	540	15.23	38.53
SULFATE (SO4-)	1000	20.82	52.66
NITRATE (as N)	15	1.07	2.71
FLUORIDE	0.24	0.01	0.03
		tot.ani%=	100

TOTAL CATIONS=	43.57	%Diff=	4.86	%
TOTAL ANIONS=	39.54			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/l
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-64
Site ID:			Samp Date:	12/13/94
Lab ID:	41370		Samp Time:	08:46

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	382

2. Calculate Concentration:

Hydroxide		OH=	-129.88
Carbonate		CO3=	0
Bicarbonate		HCO3=	466.04

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	228	11.38	45.54
MAGNESIUM (Mg++)	65	5.35	21.40
SODIUM (Na+)	190	8.26	33.07
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	466.04	7.64	37.69
CHLORIDE (Cl-)	230	6.49	32.01
SULFATE (SO4-)	294	6.12	30.20
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.34	0.02	0.09
		tot.ani%=	100

TOTAL CATIONS=	24.98	%Diff=	10.43	%
TOTAL ANIONS=	20.27			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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			Samp ID:	MV1294-65
Site ID:			Samp Date:	12/13/94
Lab ID:	41362		Samp Time:	10:13

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	174

2. Calculate Concentration:

Hydroxide		OH=	-59.16
Carbonate		CO3=	0
Bicarbonate		HCO3=	212.28

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	432	21.56	34.89
MAGNESIUM (Mg++)	125	10.28	16.64
SODIUM (Na+)	689	29.96	48.48
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	212.28	3.48	5.49
CHLORIDE (Cl-)	1570	44.29	69.83
SULFATE (SO4-)	752	15.66	24.69
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0	0.00	0.00
		tot.ani%=	100

TOTAL CATIONS=	61.79	%Diff=	-1.30	%
TOTAL ANIONS=	63.42			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV1294-67
Site ID:			Samp Date:	12/13/94
Lab ID:	41364		Samp Time:	12:18

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	247

2. Calculate Concentration:

Hydroxide		OH=	-83.98
Carbonate		CO3=	0
Bicarbonate		HCO3=	301.34

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	203	10.13	37.32
MAGNESIUM (Mg++)	53.6	4.41	16.24
SODIUM (Na+)	290	12.61	46.45
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	301.34	4.94	18.54
CHLORIDE (Cl-)	392	11.06	41.50
SULFATE (SO4-)	511	10.64	39.93
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.2	0.01	0.04
		tot.ani%=	100

TOTAL CATIONS=	27.15	%Diff=	0.93	%
TOTAL ANIONS=	26.65			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

		Samp ID:	MV1294-69
Site ID:		Samp Date:	12/13/94
Lab ID:	41365	Samp Time:	14:48

1. Alkalinity Data:

	Alk P (pH=8.3)	P=	0
	Alk MP, MO (pH=4.5)	T=	238

2. Calculate Concentration:

	Hydroxide	OH=	-80.92
	Carbonate	CO3=	0
	Bicarbonate	HCO3=	290.36

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	176	8.78	39.70
MAGNESIUM (Mg++)	54.9	4.51	20.41
SODIUM (Na+)	203	8.83	39.89
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	290.36	4.76	23.24
CHLORIDE (Cl-)	170	4.80	23.41
SULFATE (SO4-)	524	10.91	53.26
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.35	0.02	0.09
		tot.ani%=	100

TOTAL CATIONS=	22.12	%Diff=	3.85	%
TOTAL ANIONS=	20.48			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

		Samp ID:	MV1294-70
Site ID:		Samp Date:	12/13/94
Lab ID:	41366	Samp Time:	15:59

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	241

2. Calculate Concentration:

Hydroxide	OH=	-81.94
Carbonate	CO3=	0
Bicarbonate	HCO3=	294.02

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	173	8.63	39.69
MAGNESIUM (Mg++)	53.8	4.42	20.34
SODIUM (Na+)	200	8.70	39.97
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	294.02	4.82	23.56
CHLORIDE (Cl-)	169	4.77	23.31
SULFATE (SO4-)	521	10.85	53.03
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.38	0.02	0.10
		tot.ani%=	100

TOTAL CATIONS=	21.75	%Diff=	3.08	%
TOTAL ANIONS=	20.45			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22 (T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

****

			Samp ID:	MV295-01
Site ID:			Samp Date:	02/06/95
Lab ID:	41852		Samp Time:	14:00

1. Alkalinity Data:

	Alk P (pH=8.3)		P=	0
	Alk MP, MO (pH=4.5)		T=	134

2. Calculate Concentration:

	Hydroxide		OH=	-45.56
	Carbonate		CO3=	0
	Bicarbonate		HCO3=	163.48

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	94	4.69	29.77
MAGNESIUM (Mg++)	9.8	0.81	5.11
SODIUM (Na+)	236	10.26	65.12
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	163.48	2.68	16.09
CHLORIDE (Cl-)	295	8.32	49.96
SULFATE (SO4-)	218	4.54	27.25
NITRATE (as N)	13.2	0.94	5.66
FLUORIDE	3.3	0.17	1.04
		tot.ani%=	100

TOTAL CATIONS=	15.76	%Diff	-2.77	%
TOTAL ANIONS=	16.66			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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			Samp ID:	MV295-03
Site ID:			Samp Date:	02/07/95
Lab ID:	41854		Samp Time:	14:30

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	325

2. Calculate Concentration:

Hydroxide		OH=	-110.5
Carbonate		CO3=	0
Bicarbonate		HCO3=	396.5

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	240	11.98	59.79
MAGNESIUM (Mg++)	1.2	0.10	0.49
SODIUM (Na+)	183	7.96	39.72
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	396.5	6.50	37.81
CHLORIDE (Cl-)	165	4.65	27.08
SULFATE (SO4-)	289	6.02	35.00
NITRATE (as N)	0	0.00	0.00
FLUORIDE	0.37	0.02	0.11
		tot.ani%=	100

TOTAL CATIONS=	20.03	%Diff=	7.63	%
TOTAL ANIONS=	17.19			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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Site ID:
Lab ID: E95-0976

Samp ID: MV295-04
Samp Date: 02/07/95
Samp Time: 09:05

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	120

2. Calculate Concentration:

Hydroxide	OH=	-40.8
Carbonate	CO3=	0
Bicarbonate	HCO3=	146.4

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	64	3.19	26.24
MAGNESIUM (Mg++)	8.7	0.72	5.88
SODIUM (Na+)	190	8.26	67.88
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	146.4	2.40	21.07
CHLORIDE (Cl-)	210	5.92	52.01
SULFATE (SO4-)	130	2.71	23.76
NITRATE (as N)	2.38	0.17	1.49
FLUORIDE	3.6	0.19	1.66
		tot.ani%=	100

TOTAL CATIONS=	12.17	%Diff=	3.31	%
TOTAL ANIONS=	11.39			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P)

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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			Samp ID:	MV295-05
Site ID:			Samp Date:	02/07/95
Lab ID:	41855		Samp Time:	09:08

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	119

2. Calculate Concentration:

Hydroxide		OH=	-40.46
Carbonate		CO3=	0
Bicarbonate		HCO3=	145.18

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	60.6	3.02	25.48
MAGNESIUM (Mg++)	8.7	0.72	6.03
SODIUM (Na+)	187	8.13	68.50
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	145.18	2.38	19.76
CHLORIDE (Cl-)	213	6.01	49.89
SULFATE (SO4-)	159	3.31	27.49
NITRATE (as N)	1.98	0.14	1.17
FLUORIDE	3.85	0.20	1.68
		tot.ani%=	100

TOTAL CATIONS=	11.87	%Diff=	-0.72	%
TOTAL ANIONS=	12.04			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P)

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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			Samp ID:	MV295-06
Site ID:			Samp Date:	02/07/95
Lab ID:	E94-11003		Samp Time:	10:33

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	100

2. Calculate Concentration:

Hydroxide	OH=	-34
Carbonate	CO3=	0
Bicarbonate	HCO3=	122

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	120	5.99	52.17
MAGNESIUM (Mg++)	16	1.32	11.46
SODIUM (Na+)	96	4.17	36.37
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	122	2.00	19.88
CHLORIDE (Cl-)	190	5.36	53.29
SULFATE (SO4-)	110	2.29	22.77
NITRATE (as N)	5.3	0.38	3.76
FLUORIDE	0.58	0.03	0.30
		tot.ani%=	100

TOTAL CATIONS=	11.48	%ERROR=	6.59	%
TOTAL ANIONS=	10.06			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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			Samp ID:	MV295-07
Site ID:			Samp Date:	02/07/95
Lab ID:	E95-0978		Samp Time:	11:18

1. Alkalinity Data:

Alk P (pH=8.3)		P=	0
Alk MP, MO (pH=4.5)		T=	120

2. Calculate Concentration:

Hydroxide		OH=	-40.8
Carbonate		CO3=	0
Bicarbonate		HCO3=	146.4

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	89	4.44	32.44
MAGNESIUM (Mg++)	12	0.99	7.21
SODIUM (Na+)	190	8.26	60.35
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	146.4	2.40	18.63
CHLORIDE (Cl-)	280	7.90	61.33
SULFATE (SO4-)	100	2.08	16.17
NITRATE (as N)	5.72	0.41	3.17
FLUORIDE	1.7	0.09	0.69
		tot.ani%=	100

TOTAL CATIONS=	13.69	%Diff=	3.05	%
TOTAL ANIONS=	12.88			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34 (2P-T) if -,set to 0
Carbonate = 1.20P - 3.53(Hydroxide)
Bicarbonate = 1.22(T-2P) if -,set to 0

T=Total Alkalinity
P=Phenolphthalein Alkalinity

CATION-ANION BALANCE COMPUTATION SPREADSHEET

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Site ID:
Lab ID: E95-0979

Samp ID: MV295-08
Samp Date: 02/07/95
Samp Time: 11:56

1. Alkalinity Data:

Alk P (pH=8.3)	P=	0
Alk MP, MO (pH=4.5)	T=	120

2. Calculate Concentration:

Hydroxide	OH=	-40.8
Carbonate	CO3=	0
Bicarbonate	HCO3=	146.4

3. Calculate (meq/l)

CATIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
CALCIUM (Ca++)	81	4.04	28.71
MAGNESIUM (Mg++)	11	0.90	6.43
SODIUM (Na+)	210	9.13	64.86
POTASSIUM (K+)	0	0.00	0.00
		tot.cat.%=	100

ANIONS	Lab CONCE'N (mg/l)	Calculated meq/l	% tot.
HYDROXIDE (OH-)	0	0.00	0.00
CARBONATE (CO3-)	0	0.00	0.00
BICARBONATE (HCO3-)	146.4	2.40	17.54
CHLORIDE (Cl-)	290	8.18	59.79
SULFATE (SO4-)	140	2.91	21.31
NITRATE (as N)	0.914	0.07	0.48
FLUORIDE	2.3	0.12	0.88
		tot.ani%=	100

TOTAL CATIONS=	14.08	%Diff=	1.43	%
TOTAL ANIONS=	13.68			

%Difference = (sum cations - sum anions)/(sum cations + sum anions)*100

Anion Sum (meq/L)	Acceptable % Difference
0-3.0	+-0.2meq/L
3.0-10.0	+-2%
10.0-800	+-2-5%

Hydroxide = 0.34(2P-T) if -,set to 0
Carbonate = 1.20P-3.53(Hydroxide)
Bicarbonate = 1.22(T-2P)

T=Total Alkalinity
P=Phenolphthalein Alkalinity

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