LAND USE vs. WATER QUALITY

WASATCH STREAMS

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SALT LAKE COUNTY
208 WATER QUALITY
PROJECT

Salt Lake County Council of Governments
208 Study

EVALUATION OF LAND USE AND BACTERIAL WATER QUALITY IN WASATCH MOUNTAIN STREAMS SALT LAKE COUNTY, UTAH

FOR

SALT LAKE COUNTY 208

Prepared by:

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December 1976

Hydroscience

December 13, 1976

Dr. David Eckhoff
Salt Lake County 208 Project
2033 South State Street
Building #1, Room 214
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Dear Dr. Eckhoff:

In compliance with one of our specified tasks in the Salt Lake County 208 Study (Hydroscience Project No. SLCG-0115), we submit the enclosed report entitled, "Evaluation of Land Use and Bacterial Water Quality in Wasatch Mountain Streams - Salt Lake County, Utah".

This report consists of three major components: a review of available data sources regarding land use and bacterial water quality in the Wasatch Canyons from 1930 to 1975; an analysis of historical and present bacterial water quality and land use for each of the major Wasatch Canyons; and, an evaluation of the bacterial water quality impacts of each specific land use type.

Mr. Henry Nichandros of our staff performed the analyses and initial report preparation. Messrs. Thomas W. Gallagher and Eugene D. Driscoll provided technical review. We wish to express our appreciation to Messrs. Ken Watson and Steve Jensen of your staff for providing assistance in this study.

Very truly yours,

HYDROSCIENCE, INC.

Joseph M. Alcamo

JMA/cl

Enclosure

cc: T. W. Gallagher
E. D. Driscoll

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES

(Continued)

I. SUMMARY, CONCLUSIONS, RECOMMENDATIONS

A. SUMMARY

As a result of glacial action, the Wasatch Mountain Range adjacent to Salt Lake County has been dissected into six major steep-walled canyons. Within these canyons lie six streams. Water in each stream travels generally west from the headwaters to the mouth of the canyon where it leaves the Wasatch Range and flows over the valley floor to the Jordan River and then north to the Great Salt Lake. Figure 1 shows the locations of the Wasatch Mountains and streams in the eastern portion of Salt Lake County. Water quality in these streams changes rapidly from naturally clear, high-quality water to fair or low-quality water as it traverses the valley floor. Water is diverted for domestic use upstream or at the canyon mouth. The canyon and canyon streams are defined to extend from the headwaters to the mouth of the canyon where the Wasatch Range meets the valley floor. In this study, the canyon portion of the streams were analyzed.

In general, the Wasatch Mountains gain in ruggedness and altitude in the south. Little Cottonwood and Big Cottonwood Creeks are by far the highest in elevation. Some pertinent hydrologic details of each stream are tabulated in Table I. The two Cottonwoods are distinct in that they have a substantially larger discharge and receive more precipitation than the other canyon streams. The larger discharge is due in part to the less permeable rock found in the southern part of the range. Little Cottonwood (and part of Big Cottonwood) Canyon is formed almost entirely from a Pre-Cambrian/Cambrian solution-resistant crystalline (granitic) rock. Red Butte, Emigration, and Parleys Canyons are

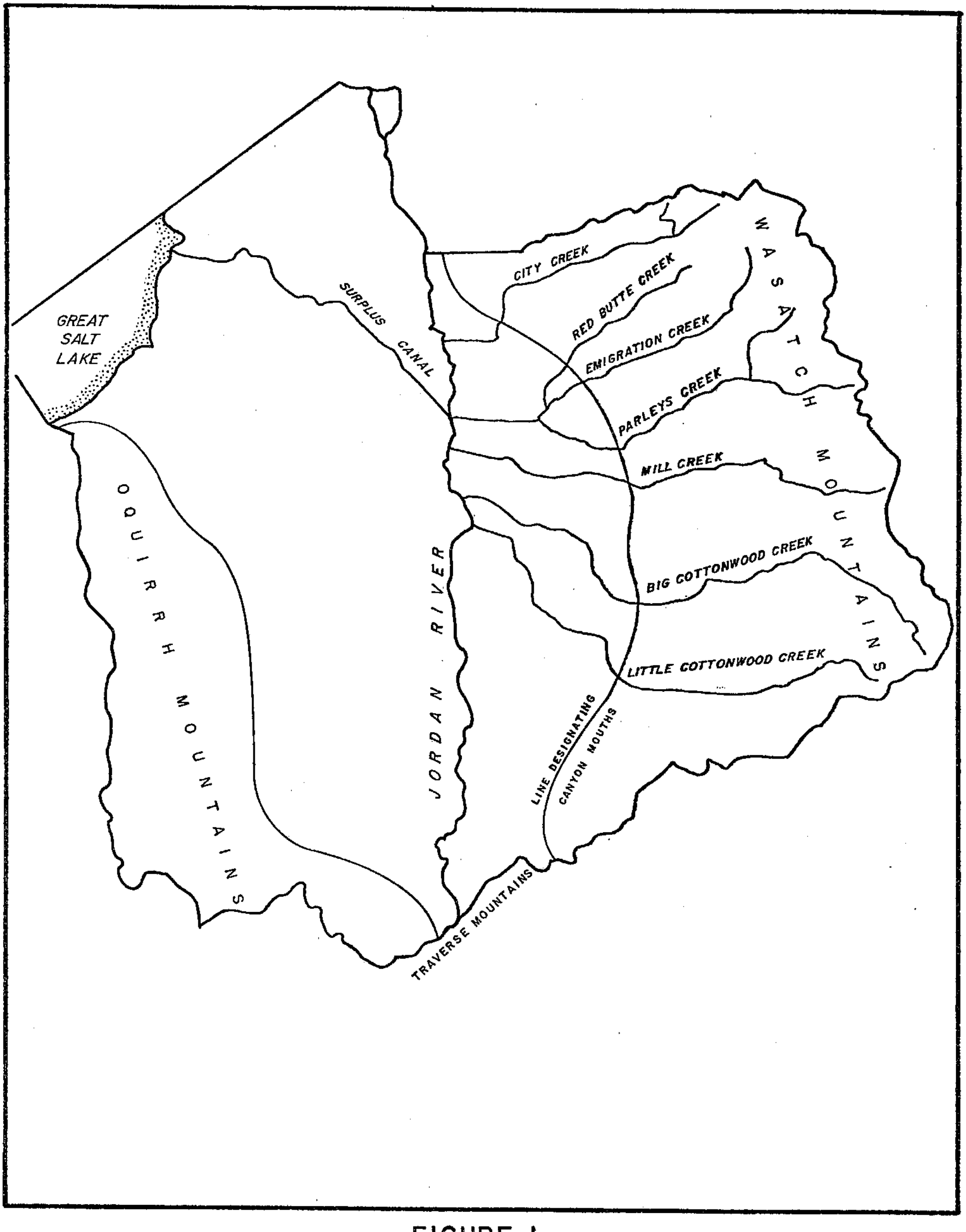


FIGURE I

STUDY AREA

TABLE I

SUMMARY OF HYDROLOGIC CHARACTERISTICS

WASATCH CANYONS

STREAM	Drainage Area (sq. miles)	Mean Elevation (feet)	Stream Length (miles)	Stream Slope (ft./ft.)	Average Annual Precip. (in.)	Average Annual Discharge 1930-1972	Average Annual Peak Discharge 1938-1971	Coeff. of Variation of Annual Discharge (1930-1972)	Channel Losses 1964-1968[1] (cfs)	Gaging Station Elevation (feet)
City Creek	17.7	7070	10	.057	31.5	15.0	63	0.28	--	4800
Red Butte Creek	7.3	6700	3	.13	30	--	--	--	--	5400
Emigration Creek	18.2	6450	10	.044	28.6	5.60	36	0.54	1.4	4870
Parleys Creek	50.7	6960	12	.041	30.8	22.6	113	0.41	2.9	4710
Mill Creek	21.7	7950	10	.071	38.0	13.4	56	0.29	2.2	5050
Big Cottonwood	50.0	8890	13	.054	44.2	64.5	360	0.22	6.5	4990
Little Cottonwood	27.4	9170	11.7	.085	49.5	60.4	384	0.21	6.6	5080

underlain mostly by shale, siltstone, and limestone of Mesozoic Age. This material is more permeable and less resistant to weathering and erosion[14]. Mill Creek and City Creek Canyons are formed in both rock types.

Because of their varying characteristics, each canyon is devoted to a different principal land use. Table II shows a simplified land use characterization of each canyon. Land use types are listed in order of their predominant usage. The Cottonwoods, being the highest and steepest canyons, attract the largest number of outdoor recreationists including hikers and skiers. The lower northern canyons are primarily residential and picnic-oriented.

Water quality varies greatly throughout the canyons and is related to land use, as explained later. Table III summarizes the present concentrations of total coliforms, TDS, chlorides, and SiO_2 in each canyon stream as measured at the canyon mouth. Water quality is given in terms of the average during the most recent three to ten years which are representative of current land use conditions.

The principal beneficial uses of the canyon streams, municipal water supply and recreation, require maintenance of public health standards appropriate for human use. The principal indicator of water quality deterioration related to those standards is the presence of excessive concentrations of coliform bacteria. Accordingly, this report uses total coliform concentrations as the basis for assessing water quality in the streams.

TABLE II

SUMMARY OF USE CHARACTERISTICS OF WASATCH CANYONS AND CREEKS

CANYON	CANYON USE	WATER USE
City Creek Canyon	1) Picnicking	1) Municipal
Red Butte Canyon	1) Natural Research Area	1) None
Emigration Canyon	1) Year Around Residential	1) None
Parleys Canyon	1) Reservoir 2) Transportation	1) Municipal
Mill Creek Canyon	1) Summer Residential 2) Picnicking	1) Irrigation
Big Cottonwood Canyon	1) Residential 3) Picnicking 2) Skiing 4) Hiking, etc.	1) Municipal 2) Irrigation
Little Cottonwood Canyon	1) Skiing 2) Hiking, etc.	1) Municipal 2) Irrigation

TABLE III

SUMMARY OF WATER QUALITY CHARACTERISTICS OF WASATCH CANYON CREEKS

CREEK (At mouth unless stated)	PERIOD OF SUMMARY FOR COLIFORM	TOTAL COLIFORMS in MPN/100 ml(1)			TDS mg/l(4)			CL mg/l(2)			SiO_2 mg/l(2)			NO_2(3) mg/l	NO_3(3) mg/l	PO_4(3) mg/l	Oil-Grease mg/l	TSS(3) mg/l
		Avg. Min.	Avg. Max.	Annual Avg.	Avg. Min.	Avg. Max.	Annual Avg.	Avg. Min.	Avg. Max.	Annual Avg.	Avg. Min.	Avg. Max.	Annual Avg.					
City Creek (at Filter Plant)	1969-74	30	150	74	190	340	280											
Red Butte Creek					300	460	390											
Emigration Creek	1969-73	1000	7000	2900	320	600	470											
Parleys Creek (at Filter Plant)	1970-75	2	60	25	270	480	400											
Mill Creek(2)	1972-74	25	250	150	300	450	360	6	35	13			11		.38		2.0	
Big Cottonwood Creek	1969-74	25	100	50	90	240	180			11(3)				0.0	.11	.02	3.4	6.7
Little Cottonwood Creek(2)	1974-75	25	50	35	80	180	130	5	14	9	4	5	5	0.0	.16	.06	2.9	1.3

(1) Sampled by SLCWD: analyzed by CCHD using the multiple tube method (MF method after June '74); 20 samples per week.

(2) TDS, CI^-, and SiO_2 has been sampled by SLCWD; analyzed by CCHD; period of summary is 1970-75 with 2 samples per month. TDS values are within 10 mg/l of those by USGS in 1964-68 (Footnote 4).

(3) Average of 6 - 10 samples from WNFS.

(4) From USGS 1964-68[14].

B. CONCLUSIONS

1. Specific Canyons

City Creek

The "natural" level of total coliforms in City Creek is 5-10 organisms/100ml (org/100ml) on the average, with a range of 2-20 org/100ml.

Past construction activity in the Canyon has resulted in year-round average coliform levels of 100-200 org/100ml. As reflected by coliform levels in the Creek, the Canyon apparently takes a number of years to recover from construction activity while erodable soil is reconsolidated.

Present summer picnic use of the Canyon results in year-round average coliform concentrations of 50-100 org/100ml with eratic temporal variations ranging from 30-150 org/100ml. These levels may be expected in the future if use of the Canyon continues to be restricted to summer picnicking activity. Under present coliform levels there are about 17 org/100ml in City Creek for every 1000 picnickers per year per stream mile.

Minimum levels of coliforms attainable today are probably about double natural levels due to patrolling and maintenance activities in the Canyon.

Emigration Creek

The "natural" level of coliforms in Emigration Creek could not be determined because historical coliform data were unavailable. It is probable, however, that the "natural" level is in the order of 1-20 org/100ml as in the other Wasatch Canyon streams.

Based upon a short period of record, the bacterial levels of the creek appear to have decreased by about 50% since 1969. Present coliform levels are still very high, however, averaging about 2900 org/100ml with a range of 1000-7000 org/100ml. High present levels of coliforms may be chiefly attributed to inadequate residential waste disposal practices, such as the use of poorly operating septic tank systems. Other canyon uses such as transportation and recreational activity may have some minor impact. Fecal coliform contamination appears to enter the creek especially in the "Kelvin Grove" to "Last Gap" reach.

As a first estimate, there are about 80 org/100ml in the stream for every cabin per mile of Creek frontage.

Parleys Creek

The "natural" level of coliforms in Parleys Creek is probably in the order of 1-20 org/100ml based upon observation of other Wasatch Canyon creeks.

Since bacterial data were very limited for Parleys Creek, no conclusions regarding historical bacterial levels could be reached.

Coliforms are presently in the order of 2-60 org/100ml at the intake of the SLC Water District below the Mountain Del Reservoir.

Though recreational activity occurs in the Canyon, its impact on bacterial quality is apparently modified by the storage of the creek water in Mountain Del Reservoir.

Mill Creek

As in the case of Parleys and Emigration Creeks, the natural level of Mill Creek could not be determined because of the unavailability of historical data. However, it is probably in the order of 1-20 org/100ml.

Before 1972, coliform concentrations ranged upward to 5000 org/100ml probably due to poor residential waste disposal practices.

With improved residential waste managment, present annual average coliform levels range from 100-200 org/100ml with monthly average variations of 25-250 org/100ml. These levels reflect impacts of summer residential and picnicking activity.

There are about 17 org/100ml in Mill Creek for every 1000 picnickers per year per stream mile. In terms of residential use, there are about 7 org/100ml in the stream for every cabin per mile of creek frontage.

Big Cottonwood Creek

"Natural" coliform levels in Big Cottonwood Creek are in the order of 1-20 org/100ml.

After 1947, coliform levels increased to an annual average of about 150 org/100ml, probably due to intensive picnic use.

During the 1950's and 1960's average concentrations were generally in the range of 8-80 org/100ml, with high summer peaks due to either construction activity of residential waste disposal practices.

Beginning in 1960, winter coliform concentrations increased over a ten year period corresponding to an increase in winter average daily traffic above 1000 vehicles/day. The rate of increase is about 5.5 org/100ml per 100 additional vehicles/day visiting the canyon in winter.

Present annual average coliform levels are about 50 org/100ml with a monthly range of about 25-100 org/100ml. These low levels are maintained despite the fact that Big Cottonwood Canyon is the most heavily year-round used canyon examined in this report.

On a year-round basis there are about 9 coliform org/100ml for every 1000 visitors per year per stream mile in Big Cottonwood Canyon.

Little Cottonwood Creek

"Natural" coliform levels in Little Cottonwood Creek are less than or equal to 10 org/100ml.

Coliform levels remained close to natural levels through the 1960's despite recreational use of the Canyon.

From 1970 to 1974, construction activity in the Canyon increased coliform concentrations up to an order of magnitude throughout the stream and throughout the year.

With existing year-round canyon use, coliform concentrations presently range between 25-70 org/100ml. These low levels are maintained despite the canyon's extensive use for summer and winter recreation. Summer activities include hiking, camping and rock climbing. Winter recreational activity principally involves downhill skiing at two major resorts having overnight accomodations.

The direct impact of skiing upon water quality appears to be minor. Average winter coliform concentrations of 10-20 org/100ml at the ski resorts may be typical for present usage represented by half a million skier visits per year.

2. Specific Land Use Impacts

Natural Coliform Levels

Based upon historical data the natural background coliform level of the Wasatch Canyon Creeks analysed is in the order of 1-20 org/100ml. Presently, if all man-related activities in the canyons were minimized, the lowest possible coliform levels attainable are probably in the order of 5-40 org/100ml due to necessary water quality surveillance and canyon patrol activities.

Construction

Construction activity involving excavation dislodges soil and removes vegetation cover. This allows storm runoff to transport coliform-containing sediment to the canyon creeks. In the Wasatch Canyons, construction has increased coliform levels in the Creeks an order of magnitude at the construction site. In City Creek, levels increased to 100-250 org/100ml and in Little Cottonwood levels increased to 40-80 org/100ml during construction activity. In City Creek it was found to take a number of years for the creek to recover from the construction activity.

Picnicking and Camping

Available data suggests that picnicking and camping in the canyons results in a creek coliform level in the order of 50-200 org/100ml. This range of values probably results from (1) the trampling of vegetation and an increase of erosion (2) improper disposal of garbage (3) inadequate sanitary facilities (4) defecation by pets. As a first estimate there are 9-17 org/100ml of coliforms in the stream for every 1000 visitors per year per mile of stream. The visitor estimates include camping and picnicking in designated and nondesignated areas.

Hiking

With respect to other recreational activities, the present amount of hiking in the canyons is small. The small amount of hiking activity which does occur is considered to have an overall minor impact upon the bacterial quality of the streams.

Skiing and Winter Canyon Usage

Skiing activity, in terms of average daily traffic (ADT) to the ski resorts, does not appear to impact the bacterial quality of the creeks at a level below 1000 vehicles/day. Above this level, the average winter coliform concentration appears to increase about 2 org/100ml for every additional 100 vehicles per day which visit the canyons for skiing. In Little Cottonwood Canyon, where skiing is the major winter activity, bacterial levels in winter have risen to about 50 org/100ml compared to a background level of about 10 org/100ml. Since coliform die-off is fairly rapid in snow little residual impact is observed beyond the skiing season. Skiers themselves appear to directly impact coliform levels only by their improper disposal of garbage. In general, therefore, skiing activity has a minor impact upon bacterial levels during the winter, and an even smaller impact on a year-round basis as compared to residential and other recreational uses of the canyons.

Residential

In Big Cottonwood Canyon, where residential wastes are transported out of the canyon, residential use appears to have a minor impact upon bacterial quality of the creek. In Emigration and Mill Creek Canyons, where septic tank disposal of residential waste is permitted, coliform levels range upward to 6000 org/100ml in Emigration and 300 org/100ml in Mill Creek Canyon, respectively, during periods of residential use in the summer.

These levels, however, represent a ten-fold improvement in coliform levels which existed before septic tank disposal was instituted. In Mill Creek, there are about 7 org/100ml for every cabin per mile of creek in comparison to 2 org/100ml for every cabin per mile in Big Cottonwood Creek. The impact of septic tank disposal appears to be particularly severe in Emigration Creek where there are an average of 80 org/100ml for every cabin per mile of creek.

C. RECOMMENDATIONS

Our recommendations regarding the improvement and/or protection of bacterial water quality in the Wasatch Canyon streams examined in this report are presented in two parts.

(1) Suggestions concerning present bacterial water quality in the specific canyons.

(2) Recommendations concerning the impact of specific activities on future bacterial water quality.

1. Improvement of Present Bacterial Quality

City Creek

It will be difficult to improve bacterial quality in this canyon unless further restrictions are placed upon summer picnicking activity. Given the present restrictions coliform concentrations are expected to average around 50-100 org/100ml. Since stricter management of the canyon would probably not substantially change present coliform levels, and since total coliform concentrations of this magnitude are not recognized as a health hazard, restricting the present beneficial use of this canyon probably would not provide a worthwhile benefit.

Emigration Creek

With average coliform levels ranging between 1000-7000 org/100ml, Emigration Creek has the poorest quality of the Wasatch Canyon streams examined in this report. High coliform levels are apparently directly related to sewage disposal practices. Present septic tank disposal is inadequate particularly within the Kelvin Grove-Last Gap reach of the canyon. An on-site inspection program of the septic systems is a suggested first step to improve bacterial quality conditions.

Consideration should also be given to transporting the residential wastes from the canyon contingent upon the results of the septic tank inspection program.

Parleys Creek

Based upon available data there appears to be no bacterial quality problem in Parleys Canyon. Monitoring should continue, however.

Mill Creek

With the present level of summer residential and picnicking use Mill Creek coliform concentrations range from 100 to 200 org/100ml on the average. This coliform level will probably be maintained if use of the canyon is not increased. Though coliform levels are not great enough to merit a major water quality improvement program, some attention may be given to restricting picnicking access to portions of the stream particularly susceptible to erosion and perhaps more closely monitoring residential waste disposal practices.

Big and Little Cottonwood Creek

Despite the great amount of recreational and residential use in Big and Little Cottonwood Canyons, the bacterial quality of their creeks is quite good. In both canyons, coliform levels presently average in the order of 25 to 100 org/100ml. The resilience of these watersheds to present levels of use makes water quality control measures, beyond those practiced now, unnecessary at the present time. Water quality monitoring should continue, however.

2. Future Canyon Development and Use

Present bacterial levels do not justify any major water quality control porgrams in any of the canyons, except for Emigration, under present levels of canyon usage. However, with future development and intensified use of the canyons, the overall bacterial quality may be degraded to an unacceptable level. It is important, therefore, to monitor and manage any future expansion of activity. Recommendations concerning specific activities are as follows.

Construction

Construction operations in the Wasatch Canyons transport coliform-containing sediment, via stormwater runoff, to the canyon creeks. In the past this has resulted in coliform concentration increases upwards to 100-250 org/100ml. Impacts have continued a number of years after the completion of construction until soil was reconsolidated and vegetation restored. If construction impacts are to be reduced, greater sediment controls than those used in the past in the Wasatch Canyons should be required. These may include 1) basins to retain runoff and sediment; 2) temporary mulching and seeding of stripped areas; 3) cultivation of especially steep slopes during construction; 4) applying crushed stone/gravel to construction roads; 5) temporary diversions of runoff around stripped areas. The applicability of these and other measures to control construction-related sediment runoff should be determined on a site-specific basis.

Outdoor Recreation (Pickicking/Camping/Hiking)

The overall impact of outdoor recreation is difficult to control on a watershed-sized scale. Some reduction of water quality impacts may be accomplished by restricting picnickers from certain erosion-susceptible portions of the stream, banning pets from the canyons, upgrading sanitary facilities, and similar measures. However, since the effectiveness of any one control measure is uncertain, it may be more reasonable to limit canyon recreational use in general. The range of 7-17 org/100ml of total coliform resulting in the stream for every 1000 recreation visitors per year per mile of stream may be used to obtain a rough idea of what bacterial levels may be expected for expanded levels of use. This figure may be used cautiously to determine the recreational capacity of the canyons with respect to bacterial quality of the stream.

Winter Recreation (Skiing)

In this study skiing activity was found to have only a minor impact upon bacterial quality of the Creeks. A total coliform increase of 2 org/100ml for each additional 100 vehicles per day over 1000 vehicles per day visiting the canyons for skiing has been found to represent present bacterial increases due to skiing activity. However, as skiing activity increases much above present levels, more significant indirect impacts may result. For example, before any new facilities are constructed to service greater skier populations, the potential water quality impacts of the resulting construction activities should be examined and minimized where possible. Other bacterial quality impacts may result from exceeding the capacity of now-adequate sanitary and garbage disposal facilities.

Residential

A figure of 7 org/100ml for each cabin per stream mile for Mill Creek may be used as an approximation for determining gross coliform concentrations due to present residential use with proper septic tank disposal. Using this figure, the residential "capacity" of the canyons may be grossly approximated.

Pascal and Eckoff[36] suggest that residential impacts can be reduced by controlling the setback distances of residences and other facilities from the streams. These authors present a table which notes the postulated setback distances in Little Cottonwood Canyon which accomplish a 99% reduction in coliform loads for different soil types and slopes. This information can be used as a guide in restricting the locations of new residences in the canyons to reduce their bacterial water quality impact.

3. General

The analyses presented in this report are sufficient to provide a general direction to water quality management of the Wasatch Canyon Creeks. Water quality monitoring of the canyon creeks should continue, however, with particular emphasis on fecal coliform data collection. Fecal coliform data (which were all-but-unavailable for this study) are more definite indicators of the public health suitability of the canyon streams than total coliforms. Data of this nature, collected in the future, can be used to refine or support the conclusions and recommendations of this report.

II. INTRODUCTION

The Wasatch Mountains in north central Utah form the backdrop and eastern boundary of the Salt Lake City Metropolitan Area. They rise abruptly from the 4,600 foot valley floor to upwards of 10,000 feet. The usually snow-capped peaks and steep canyons present a scenically pleasing view from the city and provide a summer and winter recreational playground for the 500,000 residents of the area, and to a growing extent, the rest of the nation.

The Wasatch Canyons with their green forests, granite, snow-capped peaks, and natural clear and abundant high-quality waters are in striking contrast to the generally dry and poor quality water of the neighboring areas. The canyons have, for many years, served as the primary watershed and principal recreational region for Salt Lake County residents.

In past years, the limited demands placed on the Wasatch Canyons to serve as both a water supply and recreational center were tolerable. However, in recent years, particularly with the increasing interest in outdoor recreation, the water quality has suffered. Proposed additional requirements for Wasatch water for municipal use, and the projected increased use of the canyons for recreation, poses a challenge to the canyon planners.

The purpose of this study has been to examine the relationship of water quality to land use in the Wasatch Canyons with the intention of enabling resolution of the apparent conflict of use in the most economic and effective manner.

III. DATA SOURCES

The data used in this study were taken from a variety of monitoring programs conducted by a number of local agencies. This chapter summarizes past and present monitoring programs which have produced water quality data in the canyons. All the monitoring programs have been discussed to some degree, even those which generated data either not available or not complete enough for effective use.

In this chapter, the programs are grouped in alphabetical order by agency and by canyon within agency. In Appendix A the data are grouped by canyon and data type within canyons. Sampling stations are located on Figure 2 and in more detail on the large scale maps in Appendix B. The maps in Appendix B are drawn to the scale of USGS 15 minute quadrant maps and include information on land use and developed areas [9].

A. CITY-COUNTY HEALTH DEPARTMENT (CCHD)

Since April 1972, the City-County Health Department has regularly sampled BOD and coliforms every other month at four stations located at the mouth of Emigration, Mill, Big Cottonwood, and Little Cottonwood Creeks. All stations are near Wasatch Blvd. BOD and coliform data through 1974 are presently available on STORET.

Another program, which monitors 35 additional chemicals in samples collected quarterly, has recently been instituted, but the period of record is too short to be used in this analysis.

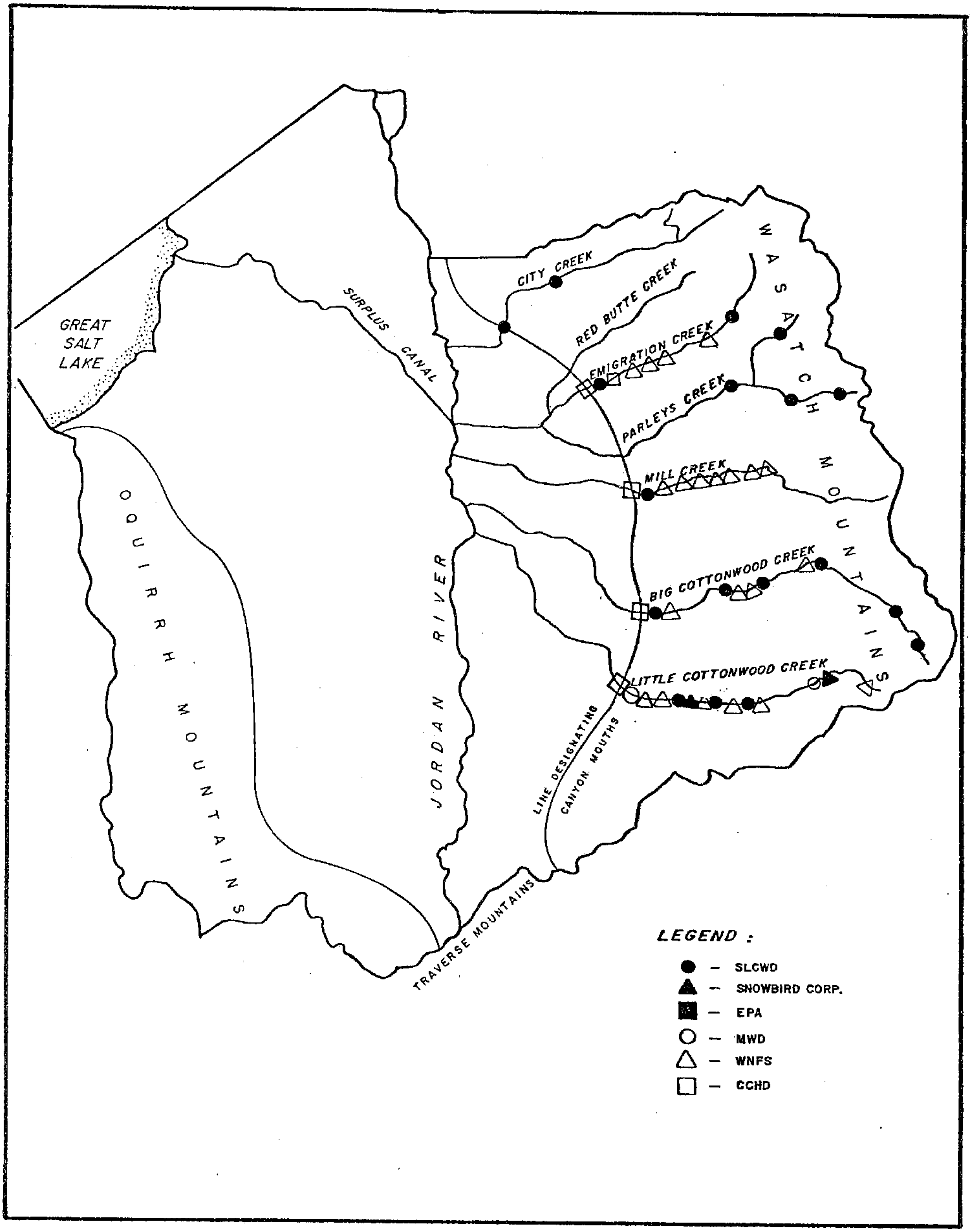


FIGURE 2

SELECTED WASATCH CANYON SAMPLING

1. Emigration, Mill, and Big and Little Cottonwood Creeks (CCHD)

The following canyon mouth stations are part of the City-County Health Department monitoring program. They are shown in Figure 2.

CREEK	CCHD#	STORET#
Emigration Creek	846	491846
Mill Creek	876	491876
Big Cottonwood	361	491361
Little Cottonwood	866	491866

The Big Cottonwood and Little Cottonwood stations are located below the water supply diversions and hence are dry many months of the year.

Data on canyon water quality from the CCHD program have not been included in this report because the data base provided is too short and incomplete to be of value in this analysis.

B. METROPOLITAN WATER DISTRICT (MWD)

This agency analyzes samples at the water treatment plant (mouth of Little Cottonwood) for coliform concentrations using both the Membrane Filter Method (MF) and the Tube Method (MPN), and chlorides, TDS, and SiO_2. This agency has had one of the most consistent and useful data collection programs in the canyon.

1. Little Cottonwood Creek (MWD)

During most of the year, the sampled water consists only of water diverted into Murray City Power Plant Aqueduct at the dam just above Wasatch Resort (see Figure 2 and Appendix B). The water is used for power generation before going to the water plant.

During times when excess (unappropriated) water flows below Wasatch Blvd., additional water is diverted from Little Cottonwood at the dam just below the Beaver Ponds and one-half mile above the water plant. This water is mixed with the Wasatch Resort water before sampling. Typically, water is taken from the Beaver Pond diversion only during the spring runoff before agricultural demands become high. Thus, except for the months of May and early June, the MWD samples represent the water quality just above Wasatch Resort. During May and June, a fraction of the water comes from the Beaver Pond Diversion, and the samples represent a mixture of waters. At no time do the samples include water from Deer Creek Reservoir which is also used at the MWD plant.

Coliform samples are analyzed three times per week (before 1975, five times per week) in the MWD laboratory from the mixture of Little Cottonwood waters entering the plant. The correlation of monthly average coliform by the MF and MPN methods is fairly good(33); however, the MF method produces values considerably lower than the MPN method.

The 1961-1975 MWD monthly average tube method coliform records at the water plant are included in this report. In general, the median value is very close to the average with a better than 90% correlation(33). Monthly average coliforms analyzed using the Membrane Filter Method are included from 1967-1975. Monthly average coliform data were assembled from the publications of Glenne(12), Wilhelm(33), and from MWD records beyond 1973. Earlier records of daily coliform counts are likely to be available.

Records of chloride, TDS, and SiO_2 concentrations are presented herein from 1961-1975 and were obtained from Glenne(12) and Wilhelm(33) for the period 1961-1974 and from the Salt Lake City Water Department for the period 1970-1976. These data represent the average of two daily composite samples taken at the water plant as described for coliforms.

C. SALT LAKE CITY WATER DEPARTMENT (SLCWD)

The Salt Lake City Water Department measures total coliform concentrations of raw water at some 20 stations along the 6 major canyon streams. The primary stations at the water treatment plants are monitored 5 times per week (beginning in mid-1975, 3 times per week). Other stations are sampled once a week or infrequently. Flow rate is measured once a day at the primary stations. The SLCWD data collection program is the most complete, most extensive, and provides the most useful data base in the Wasatch Canyons.

Samples are analyzed by the City County Health Department (CCHD) laboratory by the Membrane Filter Method. However, prior to June 16, 1974, the Multiple Tube Method was used[26]. In an analysis of the two methods, it was found that correlation of individual samples using the two methods was poor, although MF values are usually within 95% confidence limits of the MPN values. The MF values tend to be 20-50% lower than the MPN results from the same sample. When several samples are averaged by month to simulate the method used in the analysis, the correlation is much better, suggesting a highly random component as well as a systematic discrepancy between techniques. The primary effects of the Membrane Filter Method appear to be to soften the coliform peak values and to generally lower all values.

The daily coliform samples have been averaged arithmetically by month and tabulated by the Salt Lake City Water Department from 1930 to 1975 for some sample stations. The actual daily data sheets are no longer available for the early years. The monthly average data for the principal stations have been prepared for inclusion in this report and are discussed below along with the specific sampling periods and locations in the canyon.

SLCWD bacterial data presented in this report were assembled from one or more of the following sources. Discharge data were assembled primarily from SLCWD.

SOURCE	YEAR	CREEKS
Wilhelm (1974)	1967-1973-1/2	EC, MC, BC, LC
Glenne (1973)	1961-1972	LC
Jennings (1975)	1930-1973	CC
SLCWD	All Other Years	CC, EC, PC, MC, BC, LC

For late 1975 and 1976, monthly averages were made by averaging weekly values within the month and may show slight differences from the monthly values. Information on sample frequency, location, and laboratory and analysis is known for data collected during the last several years and is described below. Methods, frequency of sampling, and location are not known for the early years and may be different from that reported herein, though in the analysis we have assumed them to be essentially the same.

1. City Creek (SLCWD)

The primary monitoring station in City Creek is located at the water treatment plant midway up City Creek Canyon. Monthly average flows and coliform concentrations from 1930 to 1975 are included in this report. Except for the more recent daily data sheets of flows and coliforms, this represents all of data available from this station.

Recent data sheets indicate samples are taken at 12 Noon and 11 PM 5 days per week (3 days per week since 1975). There appears to be little difference between monthly averages of the 12 Noon and 11 PM samples and no significant or consistent differences between the two sampling times from day to day.

Coliform samples are also taken daily at the mouth of City Creek. Data from this station, "20th Ward", has not been compiled for this report because the magnitude of the effort could not be justified in the context of this program. Reduction of this data is suggested as a follow-up effort.

Coliform data and flow records are maintained in Emigration Creek at the mouth near Tunnel Springs. This station is labeled "Lower Emigration". Coliform concentrations are also monitored within the canyon at Burr Fork (Upper Emigration) just above the bridge where the highway crosses to Parleys Canyon. Both stations are shown in Figure 2.

Monthly average coliform data, sampled once per week, are presented in this report for 1968-1975 and 1969-1975 for Lower and Upper Emigration respectively. Monthly average flow records have been included for the Lower Emigration Station near Tunnel Springs from 1930-1975. This is believed to cover the entire period of both bacterial and discharge data collection.

There are four stations at which SLCWD monitors coliform concentrations in Parleys Canyon on a weekly (or less frequent) basis. These are in Upper Lambs Canyon, Lower Lambs Canyon, and Little Dell Reservoir. Data from the three stations above Mountain Dell Reservoirs are included for 1974-1975. Earlier data may be available, but they were not obtained in this study. Monthly averaged values at the filter plant below Mountain Dell Reservoir are presented from 1970-1975. This is believed to be the entire record at this site. Flow is monitored below the Dam and records have been included from 1930-1966. More recent flow records are available but were not obtained.

Below the Reservoir, Parleys Creek flows into a culvert for the remainder of its traverse through the canyon to the mouth.

2. Mill Creek (SLCWD)

The SLCWD samples only one station in Mill Creek. This station is at the mouth at Boundary Springs where discharge and coliform concentration have been measured for many years. Discharge is measured daily; coliform appear to be measured weekly.

Chlorides and SiO_2 were also measured at this station on a regular basis. However, no reference to these measurements can be found in other publications except as reported by Wilhelm(33) covering the period January, 1971 to September, 1974. Monthly chloride and TDS data are included herein. Annual SiO_2 data are included for 1971-1973.

Monthly coliform data are presented from 1967 to 1975. Earlier data may be available. Monthly discharge data are presented from 1930 through 1975. This is believed to represent the entire period of record.

3. Big Cottonwood Creek (SLCWD)

The principal sampling station on Big Cottonwood is at the mouth of the creek at the water treatment plant. Both flow rates and coliform concentrations are measured. Monitoring of total coliforms has been conducted since at least 1930. Samples have been taken 5 days (since 1974, 3 per week) per week at 6 AM and 7 PM. The 6 AM sampling appears to have been discontinued in early 1975. There appears to be little difference between the water quality at 6 AM and 7 PM. Monthly coliform averages and stream discharge are reported herein from 1930 to 1975. This comprises all of the available coliform data except for the individual daily data of recent years.

Coliforms are monitored by SLCWD once a week or less at 5 other stations within Big Cottonwood Canyon. These stations are located on Figure 2 and are described as:

NAME	RELATION TO WNFS STATIONS
Storm Mountain	Below BC-2
Mill B	1 Mile + above BC-3
Mill D (Reynold's Flat)	Above BC-8
Silver Fork	
Brighton	

4. Little Cottonwood (SLCWD)

The principal SLCWD station in Little Cottonwood is at the mouth where coliform samples have been taken 5 (3 recently) times per week since at least 1931. Average monthly coliform data for this SLCWD station are presented for the period of record 1931-1975 with the exception of nine years from 1949-1959. Monthly average data for these nine years are apparently missing from the SLCWD's library. Consequently, this represents the entire period of available coliform records.

The location of this station has been the topic of considerable debate because comparison of daily, monthly, or yearly averaged coliform levels from the SLCWD and the MWD monitoring programs do not agree, and some published and unpublished maps and reports show the stations at different locations. Further discussion of the discrepancy between these results can be found in the discussion of Little Cottonwood found in this report.

Descriptions, however, of the SLCWD[26] station locations show them to be located in exactly the same place and to be subject to the same mixing of water from the two Little Cottonwood diversions. The primary diversion for water sampled under this program is just above Wasatch Resort.

Total daily flow in Little Cottonwood at the mouth is measured by SLCWD and reported herein as a monthly average from 1930-1975. The flow at the mouth includes the loss by diversions.

SLCWD operates four other stations in Little Cottonwood Canyon that are sampled daily or less frequently for coliforms. They are described as:

NAME	RELATION TO WNFS STATIONS
Red Pine	Below LC-3 (WNFS)
White Pine	Below LC-5 (WNFS)
Peruvian	Between LC-6 and LC-7 (WNFS)
Below Snowbird	Below LC-8 (WNFS)

The period of record for these stations is unknown and only data for Peruvian and Snowbird have been included in this report. For these stations, the included data from 1971-1975 probably represent the period of record. Operation of the Red Pine and White Pine stations was found to be sporadic in 1975. No data were found in the 1974 records, nor after March, 1976. The stations may have been discontinued.

D. SNOWBIRD CORPORATION (SBC)

At least four Snowbird water quality programs have been or are presently being conducted by Cortell and Associates to monitor pertinent water quality parameters throughout Little Cottonwood Canyon. Detailed descriptions of these programs and others in Little Cottonwood Canyon are contained in the Snowbird publication by Cortell[5]. Only the two ongoing programs are discussed herein. The Snowbird programs are the most comprehensive programs in the canyons. A wide range of parameters are monitored at several sampling stations along Little Cottonwood. The single drawback is presently the short period of record, beginning in the early 1970's.

1. Little Cottonwood (SBC)

The first Snowbird Water Quality program consists of measuring three parameters: suspended solids, coliform, and BOD sampled at intervals of approximately 8 days. This program was instituted on March 19, 1973, and consisted of the 6 stations described below. Stations 2 and 6 are shown on Figure 2. In June of that year, Station 1 was dropped and Station 2A was added.

STATION	LOCATION
1	Above confluence of the Mine Tunnel Drain
2	Below the Mine Tunnel Drain at Cliff Lodge
2A	Skiers Bridge
3	Below the Plaza
4	Below Wilbur Ridge Lift
5	Below Gad 1 Lift
6	Below Red Pine Creek

Samples are collected and analyzed by Ford Chemical Laboratories using standard methods (multiple tube tests for coliforms). Monthly averages of all Station 2 and Station 6 data from this first program through 1975 are shown in Appendix A.

The second Snowbird program is called the Snowbird Source Control Water Quality Program and consists of 20 stations. In this program, each station is sampled monthly and analyzed by Ford Laboratories for 35 different constituents. The program began on February 8, 1975. Data from this study have not been included in this report.

E. U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

From June 19 to June 25, 1972, the Environmental Protection Agency, Surveillance Branch, conducted an intensive survey of the Jordan River and Emigration Creek.

1. Emigration Creek (EPA)

EPA measured temperature, pH, DO, conductivity, total coliform and fecal coliform once a day throughout the 7-day period at 7 stations in Emigration Canyon. These stations are shown on Figure 2 and the map of Emigration Canyon in Appendix B. They are numbered in descending order from the mouth to the headwaters, i.e., EC-8 to EC-1. EC-2 is on a side stream. The data is shown in Appendix A. Additional data not reported herein are available for the three stations below the canyon mouth and several stations along the Jordan River.

F. UTAH STATE DEPARTMENT OF HIGHWAYS (HWY)

The research section of this agency, in cooperation with the Bureau of Public Roads, publishes monthly data on Average Daily Traffic (ADT) near the mouth of Mill Creek, Big Cottonwood Creek, Little Cottonwood Creek, and Parleys Canyon. Annual estimates are available for Emigration Canyon.

1. Little Cottonwood Creek (State)

Two State sampling stations are located in the Canyon portion of Little Cottonwood Creek. These are at the Power Plant and Wasatch Blvd. They are not shown on Figure 2 but are located about one mile upstream and one mile downstream of the Murray City Power (MWD) Aqueduct.

Monthly coliform data have been included in this report as summarized by Cortell[(5)]. The data represent coliform concentrations from 1966-1974 and from 1966-1971 measured at Wasatch Blvd. and the Power Plant above Wasatch Report respectively. It is believed only one sample per month is taken. Many months have no data.

G. WASATCH NATIONAL FOREST SERVICE (WNFS)

The Wasatch National Forest Service conducts a water quality monitoring program consisting of 24 stations on Mill Creek, Big Cottonwood Creek and Little Cottonwood Creek. Samples were collected occasionally from May, 1972 to September, 1972. Since then, sampling has been conducted monthly, and occasionally, twice per month. The stations are shown on Figure 2. They are labeled consecutively from the mouth of the respective streams, e.g., LC-1 through LC-9.

The following constituents are usually measured:

Total Coliform	NO_2-N	TSS	BOD_5
Fecal Coliform	NO_3-N	TDS	DO
Grease & Oil	PO_4-P	Cl^-	

Most of the information from this program is sketchy and incomplete and extends over a very short period of record. Sampling dates are irregular and the number of constituents analyzed vary. Hence, it was not found to be

1. Mill Creek and Big and Little Cottonwood Canyon

The data presented in this report are the monthly average ADT at the canyon mouth for the period of record which is from 1967-1973 for Mill Creek (1974-1975 not obtained), 1955-1975 for Big Cottonwood, and 1948-1975 for Little Cottonwood. Data assembled for these canyons represent two direction traffic whose destination is within the canyon. The data were assembled from the sources of Glenne[12], Wilhelm[33], and direct contact with the Utah State Department of Highways.

Except for the daily and weekend average ADT data for the above periods, the data in this report represent all available traffic data for these canyons.

2. Parleys Creek (HWY)

Traffic data are measured in Parleys Canyon at the mouth. The heaviest traffic volumes occur in this canyon which is the location of Interstate 80. Most of the traffic is through traffic.

3. Emigration Canyon (HWY)

The only data on Emigration Canyon ADT is the average annual ADT for 1973 (3700 vehicles per day). This information has been provided by PBQ&D[9]. ADT for Emigration Canyon may not represent total trips to locations within the canyon as the highway loops back to Parley's Canyon.

H. UTAH STATE ENVIRONMENTAL HEALTH BUREAU (STATE)

According to the Snowbird Report[5], the State Environmental Health Bureau has irregularly collected water samples from Little Cottonwood since 1966. They have performed MPN coliform, some BOD, and a few suspended solid analyses at three stations since 1966. It is likely the State samples other streams. The data appears to represent only a single sample per month with no data at all in many months. Hence, the data are of little use in this analysis.

particularly useful in this report, especially for the purpose of presenting monthly summaries. However, some of the parameters sampled are not otherwise available. Annual summaries (usually from only 6 to 10 samples) of these parameters have been included in Table III where available. Monthly summaries were not made because of the incompleteness of the data obtained.

I. OTHER SOURCES

During the middle 1960's the U.S. Geological Survey (USGS) conducted an intensive survey of the Jordan River Valley and the Wasatch Canyon Streams. Some data, particularly TDS, are available from this study and have been incorporated into Table III[14]. The TDS data reported by the USGS from 1964-1968 agree quite closely with recent data collected by MWD and SLCWD. Additional chemical data are available.

The Salt Lake County Council of Governments (COG) is currently conducting limited studies of several parameters on Little Cottonwood, Emigration and Red Butte Creeks. These studies, which are of the same scope as the EPA Emigration Creek study described herein, are described as a part of a recommended monitoring program[15].

The STORET data retrieval system provides a possible auxiliary source of data from selected agencies (described in this chapter) who also enter their data into the system; these are CCHD, the State, and the WNFS. However, these sources do not have the most comprehensive data collection programs, and not all of the data collected are entered.

IV. A REVIEW OF CANYON LAND USE AND WATER QUALITY

Land use and water quality has changed dramatically in the Wasatch Canyon during the last 40 years. The influx of people to the Salt Lake City area following World War II and the recent increase in outdoor recreational activities, particularly hiking, skiing, and camping during the 1970's, have altered the character of the canyons. Likewise, with increasing use, the water quality of the canyons has also changed.

In this section, the present and historical land use of each canyon is described, and this in turn is related to the present and historical water quality with particular emphasis on the bacterial levels.

A. AN OVERVIEW

Historical water quality records, back to 1930 in some cases, show that most canyons streams have undergone similar changes in bacteriological composition. Prior to 1940, water quality can be said to represent "natural" condition. The minor amount of development in the canyons probably had little effect on the coliform concentration. In the late 1940's concentrations of coliforms increased rapidly with the influx of people to Salt Lake City. Between the mid-1950's and 1960's quality appears to have improved either through improved management or a change in climatic conditions. In the late 1960's, with the increased awareness of the outdoors, use of the canyons became intense. Traffic volumes were up nearly an order of magnitude. Bacterial quality deteriorated in nearly all streams.

In the 1970's, water quality has been improving, especially in the more recent years (1973-1975). The cause can be debated and perhaps no single factor has led to the improved quality. Possible explanations include: 1) an improved wastewater management program arising out of concern for the environment and the domestic water supply; 2) increased dilution by high rainfall in recent years; 3) the change from the Multiple Tube Method (MPN) to the Membrane Filter Method (MF) of analysis for coliform content, leading to an apparent improvement. Of these reasons, number 1 appears to be most likely. Precipitation seems to play a minor roll in dilution because bacterial load increases with increased streamflow. An evaluation of the MF results and split samples analyzed by both MF and MPN methods showed the MF method probably produces lower values but not less than 2/3 of the MPN values when several samples are averaged by month.

Presently, the use of nearly all canyons is intense. However, the type of land use in each canyon is different. Table IV summarizes the land use capacities of each of the canyons giving the number of parking spaces, cabins, picnic spaces, etc. Table V shows the actual usage of each cabin during 1974 as reported by the Division of Highways, Wasatch National Forest Service, and the ski resorts. This table can be used as a guide to determine the relative use of each canyon. However, the number of visitor-days reported does not include all usages. Omitted are the use of cabins and perhaps some recreation in unrecorded areas. The reported recreational use accounts for less than half the average non-commercial (80% of total) average daily traffic (ADT) at 2 persons per vehicle.

B. CITY CREEK CANYON

1. Present and Historical Use

City Creek is a primary water supply for the Salt Lake City Water Department (SLCWD) which owns the watershed. As such, use of the canyon is restricted. No cabins, overnight camping, or permanent residences are allowed. Public use of the canyon is restricted to hiking, fishing, picnicking, hunting, and other daylight

TABLE IV
SUMMARY OF LAND USE CAPACITIES*

CANYON	Parking Spaces	No. of Cabins[1]	Lodging Cap. Persons[2]	Campground Cap. Persons	Picnic Area Cap. Persons	Restaurant Scats	Ski Lift Capacity Pers/hr	Ski Operators Living In Canyon	1974 Recreational Use, In Visitor Days
City Creek Canyon	NA	0	0	0	845[3,4]	0	0	0	22832/NA
Red Butte Canyon	0	0	0	0	0	0	0	0	NA
Emigration Canyon	NA	236	NA	NA	NA	NA	0	0	NA
Parleys Canyon	NA	224/NA	0	NA	NA	NA	0	0	NA
Mill Creek Canyon	NA	72/NA	NA	NA	1907/NA	NA	0	0	245,000
Big Cottonwood Canyon	1,350/NA	440	135	685/NA	1530/NA	425	3800	10	295,000
Little Cottonwood Canyon	2,600/NA	63	2297	480	0	1835	11000	425	618,100

* Source: EDAW (1976)

(1) Capacity of each cabin is approximately 5 persons. Cabin numbers include both seasonal and year-round residences.

(2) Commercial lodging including guests or employees staying in condominiums, hotels or lodges.

(3) This number is distributed between 18 separate picnic sites.

(4) Source: Salt Lake County Planning Commission, 1975.

/NA Though additional land use of this type is known to occur in the Canyon, information on additional capacities was not readily available.

NA Though this land use type does occur in the Canyon, information on existing capacities was not readily available.

TABLE V
SUMMARY OF 1974 CANYON USAGE

CANYON	1974 AVERAGE DAILY TRAFFIC			1974 REPORTED RECREATIONAL USE IN VISITOR DAYS[2]						RESIDENCES
	Summer May-Oct	Winter Nov(73)-Ap	Annual 1974	Picnic	Camping	Hiking	Skiing[3]	Other[4]	Total	Number Of Cabins
City Creek Canyon[5]	NA	NA	NA	22,832	0	NA	0	0	22,832/NA	0
Red Butte Canyon	Public	Autos	Prohibited	0	0	NA	0	NA	NA	0
Emigration Canyon	NA	NA	3,700[6,7]	NA	0	NA	0	NA	NA	236
Parleys Canyon	NA	NA	11,573[6,7]	NA	NA	NA	0	NA	NA	224/NA
Mill Creek Canyon	1,924[7]	548[7]	1,318[7]	72,200	0	29,800	0	143,000	245,000	72/NA
Big Cottonwood Canyon	2,751	1,862	2,269	54,800	42,600	35,400	100,000	117,000	295,000	440
Little Cottonwood Canyon	2,027	2,952	2,530	0	10,600	6,900	503,900	96,700	618,100	63

(1) Two way traffic volume. Source: Utah Div. of Highways (1976).

(2) Source: Jim Paschal, U.S.F.S. files, 1975 as Reported by EDAW (1976)

(3) Skier visits for 1973-1974 season. Source: Wilhelm (1974).

(4) "Others" include visits to reservoirs, lakes, streams, and primarily roads.

(5) City Creek Canyon above the filter plant. Source: SLCWD, Sherwood (1976)

(6) Through traffic exists in these canyons. Source: EDAW (1976)

(7) 1973 Datum

NA Though this type of use is known to occur in the canyon, information was not readily available.

NA Though additional use of this type is known to occur, information on additional capacities was not readily available.

activities. Plant operators and the SLCWD personnel have access to the canyon to operate the facilities.

Vehicular access to the canyon is controlled at the mouth and also at the SLCWD Water Treatment Plant part way up the canyon. Bicycle and foot traffic are not controlled.

Currently, and for the last several years, the lower gate remains locked until May 30 of each year. At this time, the public has unrestricted summer use of the lower portion of the canyon. However, use of the upper canyon is restricted by permit to the number of available picnic sites. All sites are usually filled each weekend. In 1974 and 1975, 22,832 and 22,419 picnickers, respectively, registered to use the upper canyon.

The entire City Creek Watershed is closed to the public in the fall (date unknown) except for deer season from October 20 to 30, when 35 cars are allowed past the upper gate.

Historically, the use of City Creek has increased dramatically over the last 30 years from very little use to the intensive picnic use described above. A chronology of events showing the historical use of the canyon is presented in Table VI. After World War II, the use of City Creek for picnic, hiking and fishing activities increased dramatically. In February, 1952, all public vehicular access to the upper canyon (lower canyon access is unknown) was discontinued and the canyon was officially closed by SLCWD. This apparently was considered necessary to protect the quality of the municipal water supply. The canyon remained closed until August 10, 1966, when it was reopened to the public on the restricted basis described earlier.

TABLE VI

CHRONOLOGY OF EVENTS IN CITY CREEK

DATE	EVENT
1946	Increased interest in recreation (end of war)
Dec. 1951	Heavy winter deer kill (1356 deer killed in valley)
Feb. 1952	Canyon closed
1952-3	Water Treatment Plant constructed
Feb-Jul 1954	Diversion-Intake pipe constructed
Feb. 1955	Beaver Dam broke
Apr. 1955	Water Treatment Plant opened
Oct. 1955	Winter deer kill (307 deer killed in City Creek Canyon)
Oct. 1957	Winter deer kill (165 deer killed in City Creek Canyon)
Aug. 1966	Canyon opened for limited public use
Jun 1974	Coliform analytical method changed (MPN-MF)
1974	22,833 people reserved park (5700 visitor days)

Shortly after the canyon closing, construction began on the water filtration plant located just above the diversion site in mid-City Creek Canyon. The construction involved large excavation and the movement of earth near the stream. From February to July, 1954, the final connections from the diversion to the plant were made; and on March 25, 1955, the plant was put into operation.

2. Water Quality

Figure 3 (a) shows the trend in the average annual coliform concentration from 1930 to 1975. The trend in coliform concentrations very closely follows the reported changes in canyon use, and hence, provides significant support to a popular hypothesis[16] that intensive recreational use of the canyon is largely responsible for the deteriorated quality. Furthermore, the data indicate construction activity is also a primary source of pollution.

Average water quality in the 1930's, during a period of little use, show coliform concentrations below 10 MPN/100 ml. During the 1947-1954 period of intensive picnic use followed by construction, the bacterial concentration of City Creek increased to 150 MPN/100 ml. This was followed by a period of declining concentrations and a near return to the 1930's levels during the period when the canyon was closed. When the canyon was reopened, coliform levels rose again into the 100's.

A more detailed display of coliform concentrations is presented in Figure 4 which shows the monthly average concentrations through this period from 1930-1975. Monthly concentrations during the two periods (1930-1945, 1955-1965) when the canyon was either unused or closed are very consistent from year to year. They show little indication of man-induced disturbances or other irregularities. Concentrations typically rise sharply on the falling leg of the hydrograph to peak

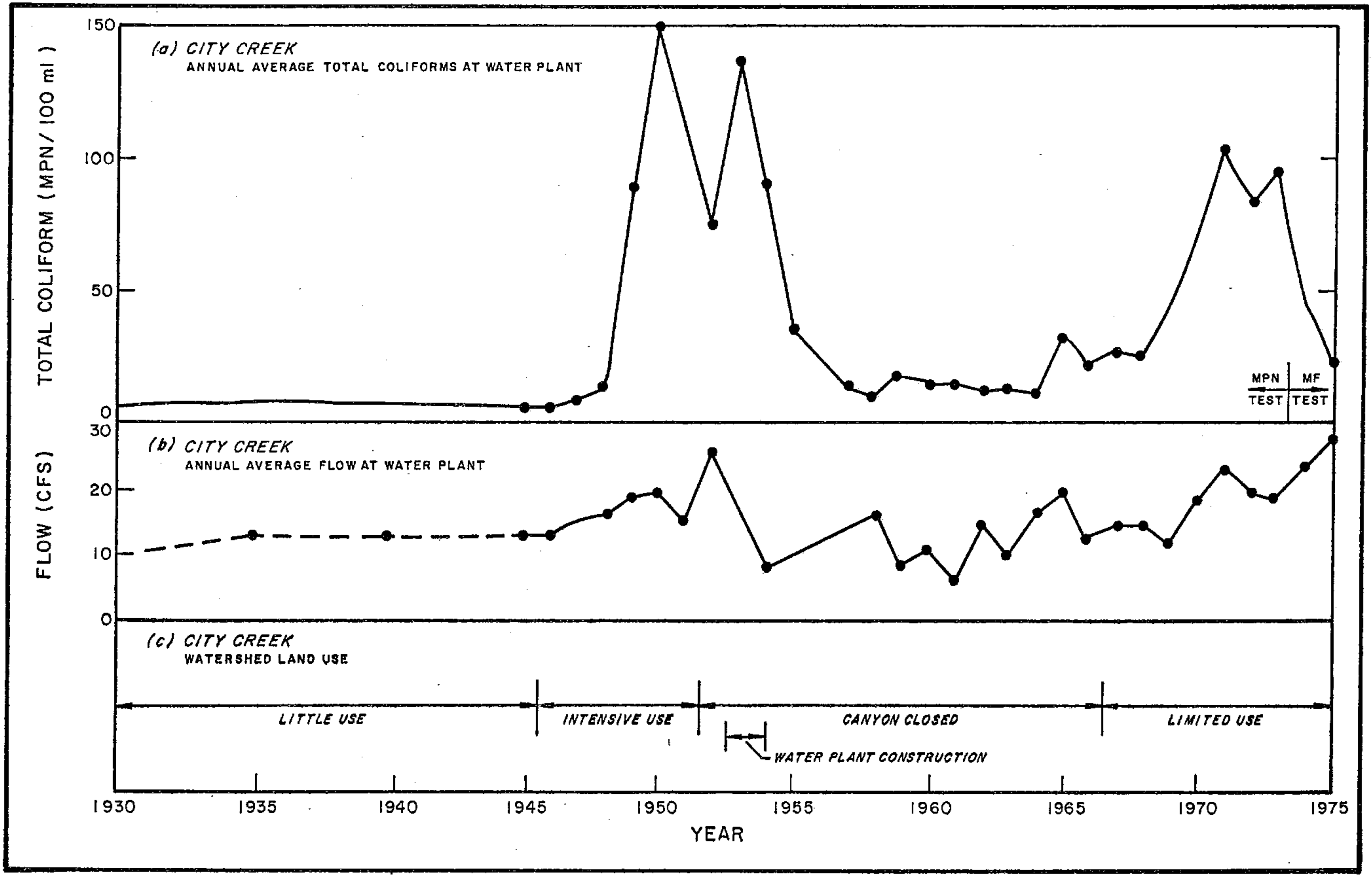


FIGURE 3

CITY CREEK LAND USE AND CORRESPONDING ANNUAL AVERAGE FLOW AND COLIFORM CONCENTRATION AT WATER PLANT

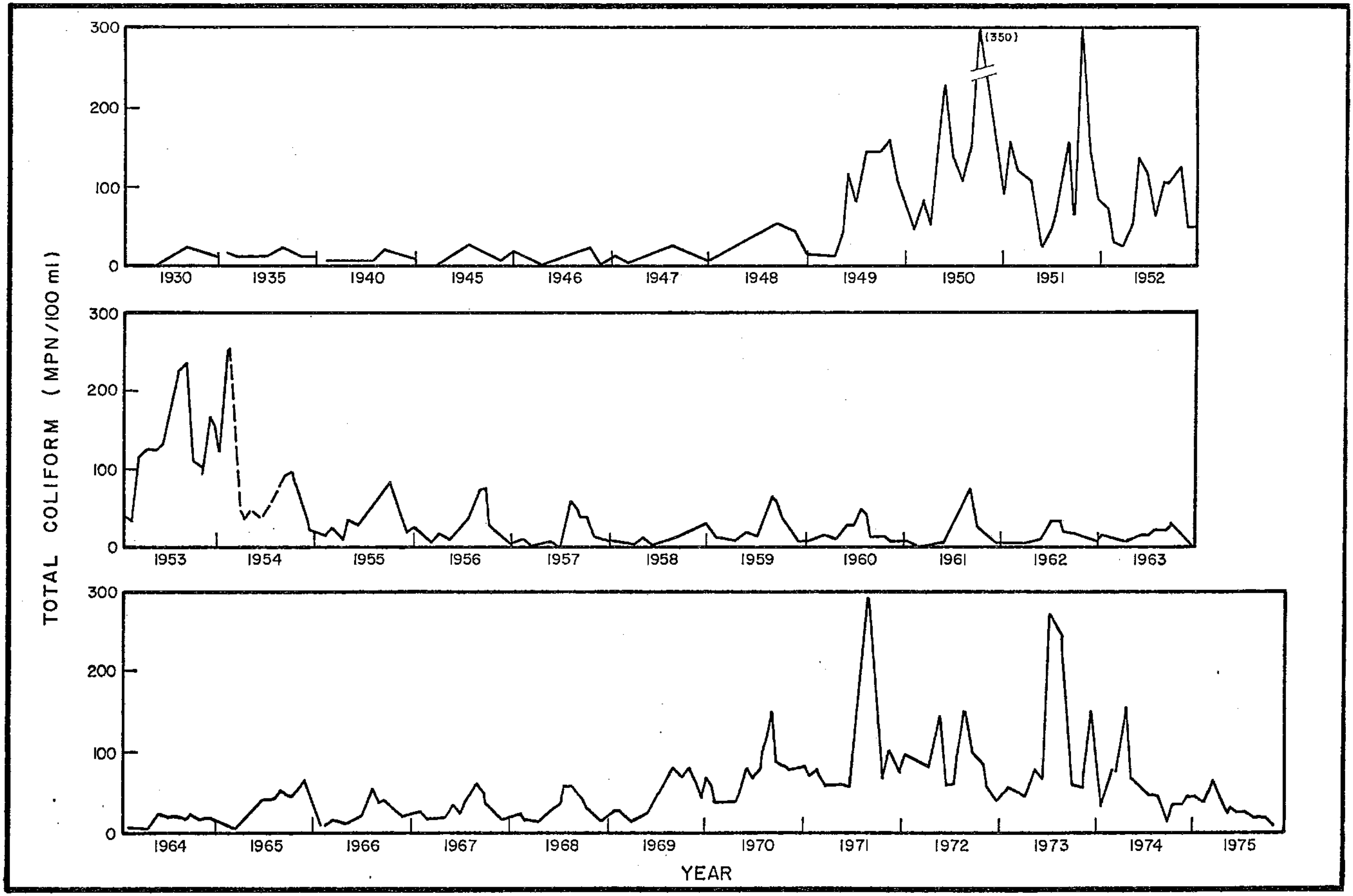


FIGURE 4
CITY CREEK, MONTHLY AVERAGE TOTAL COLIFORM, 1930-1975

in the July-September period and then decline to a minimum in the winter. Bacterial concentrations when the canyon was closed were twice the "natural" concentrations of the earlier years. Thus, with no recreation, no construction, and little use, bacterial loads approached natural conditions but were kept slightly higher, probably as a result of canyon disturbance due to policing and operating canyon facilities. Concentrations observed in the early 1960's (Figure 4) which vary between 10 and 40 MPN/100 ml are likely to be close to the minimum practicably attainable pollution levels for City Creek in modern times.

In 1947, quality began to deteriorate dramatically during a time of increasing recreational use and concentrations were generally much higher from 1949-1951. The temporal variation of coliforms (Figure 4) exhibited wide variations during this period of extensive picnic use, quite unlike the regular and predictable characteristics of the 1930's and 1940's.

In 1952, the canyon was closed, and coliform levels dropped substantially in response. However, the construction of the Water Treatment Facility in 1953, and the associated earth movement, brought concentrations back up. During the construction, concentrations were not erratic but instead remained consistently high indicating a coliform loading proportional to the flow as would be expected if the bacteria were tied to the eroded sediments. Even the spring runoff carried considerable bacteriological material, probably tied to the sediments from the construction site.

Immediately after construction ceased, the watershed began to return to normal. The recovery period took five to nine years as the annual average and summer peak concentrations as shown in Figure 4 returned to normal. This may correspond to the time required for the revegetation and consolidation of erodible materials at the construction site.

In recent times, the quality of the canyon waters has again been deteriorated, as in the early 1950's. As in the previous period of heavy use, the temporal variation of coliforms is very erratic. Recent water quality records show the average annual coliform concentrations range from 50 to 100 MPN/100 ml while monthly variations may be 30 to 150 MPN/100 ml. Concentrations shown in Figures 3 and 4 imply an improvement in water quality after 1973. However, there is insufficient water quality data and no land use data to verify an improvement. In addition, considering the change to the Membrane Filter Method in June of 1974, the suggestion of a major improvement in quality may not be supported.

3. Conclusions and Summary

The following conclusions can be drawn from the above analysis.

(1) Average annual "natural" coliform levels in City Creek are 5 to 10 MPN/100 ml. Monthly values range from 2 to 20 MPN/100 ml.

(2) Because of necessary patrol and operational personnel and other unavoidable factors, modern day minimum obtainable pollution levels may be twice that of the watershed under "natural" conditions.

(3) Water quality is degraded by picnickers and other day-type users. Annual average coliform concentrations increase by an order of magnitude to around 100 MPN/100 ml with picnic use.

(4) Picnic use, when restricted to summer only, increases coliform pollution proportionally all year around. Picnic-type use produces temporal coliform levels that are very erratic, probably unpredictable, and inconsistent from year to year.

(5) Construction activity (especially excavation) causes large year-round increases in total coliform concentrations. Concentrations may be 100 to 200 MPN/100 ml throughout the year.

(6) It probably takes several years for a watershed to recover from a period of use, while erodible material is consolidated and revegetated.

(7) With the present limited use restrictions continuing in upper City Creek, future coliform concentrations and coliform variations can be expected to be similar to those of the early 1970's.

C. RED BUTTE CANYON

Red Butte Canyon is completely closed to the public. There are no cabins, camping sites or picnic sites, and the entrance is closed to public motor vehicles. A few land owners have access to the canyon. It is also presently serving as a National Forest Natural Research Area for environmental studies.

No data is available with which to make any significant analysis of land use and/or water quality levels.

D. EMIGRATION CANYON

1. Land Use and Management

Emigration Canyon is a heavily used residential area. Cabins are used all year around, some for permanent residences. Currently, there are 236 cabins in the canyon. The density of development is higher in Emigration Canyon than in any other. There are approximately 29 developed acres of land along each mile of stream. The annual average daily traffic (ADT) of 3700 vehicles/month (in 1973) is the highest of any canyon road except for Interstate 80. Additional, unmeasured traffic enters at the top of the canyon from I-80. Development along Emigration Creek is fairly uniformly distributed and is situated close to the stream. Figure 5 shows the distribution of developed areas.

Canyon use is mostly residential with some minor recreational use. There are no known picnic or camp sites in the area nor is it used for municipal water supply by the SLCWD.

Emigration Canyon is extremely steep-walled, and the valley floor is generally narrow. Little acreage is available for the construction of buildings, residences, or septic tank drain fields. In many locations, cabins are sandwiched tightly between the creek and the highway.

Little is known about past water quality management in this canyon. Recently, water quality comparisons between those water supply canyons with controlled wastewater programs and the others, such as Emigration and Mill Canyons, has led to a better management program in the uncontrolled canyons.

In the early 1970's, steps were reportedly taken to improve the operation of septic tanks and to eliminate leaky storage vaults. Recently, restrictions have been placed on livestock grazing. Leashed dogs were formerly allowed, but they are now prohibited entirely.

2. Water Quality

Water quality in Emigration Creek is the poorest of all canyon streams. Coliform levels average 2000 to 7000 MPN/100 ml and exhibit monthly average peaks often above 10,000 MPN/100 ml. According to the results of a recent EPA study[29], fecal coliforms make up a substantial portion of the total coliform load. Dissolved oxygen levels, however, remain near saturation.

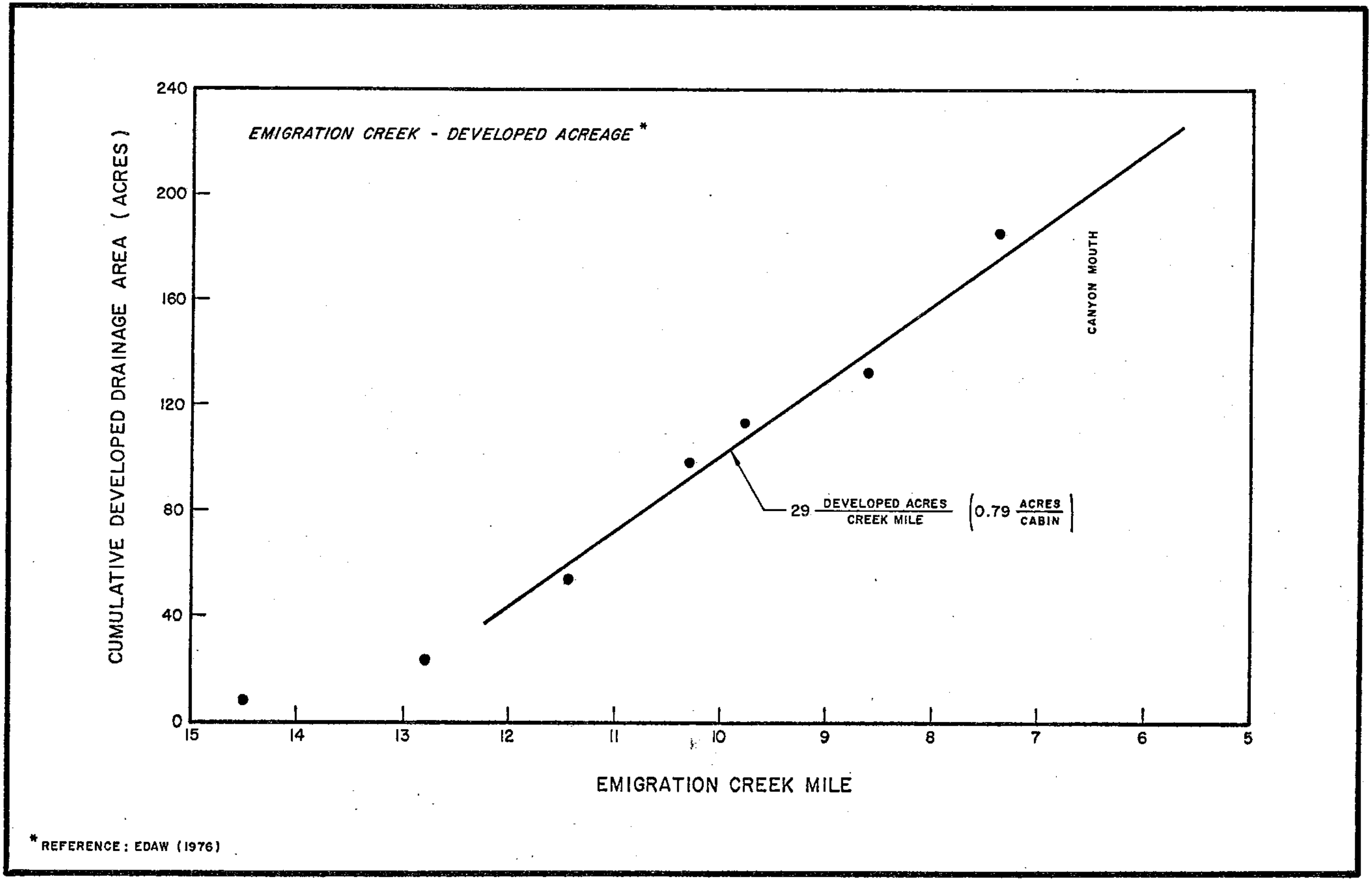


FIGURE 5
CUMULATIVE DEVELOPED ACREAGE IN DRAINAGE AREA OF EMIGRATION CREEK

The source of the high coliform levels appears to be the residential users of the canyon. Dense residential areas adjacent to the creek, steep slopes, poor septic tank soil characteristics, and a poorly managed wastewater control program have resulted in a great deal of contamination by septic tanks and other residence-related activities such as construction, excavation, and off-road vehicle operation.

Figure 6 shows the annual trend in coliform concentration, loadings, and flow rate at the mouth of the canyon. Annual average concentrations below Burr Fork at the upper Emigration station are also shown. Coliform concentrations appear to have declined since 1968 from 5000 to less than 2000 MPN/100 ml.

Substantial improvements appear to have been made in 1969 and perhaps 1968. During this period, coliform concentrations and loads were reduced significantly. Neither loads nor concentrations have returned to the pre-1970 levels. The improvements in water quality appear to be related to the upgraded waste control program. However, this cannot be substantiated because of the lack of historical information from the canyon patrol program. Also, the short period of record precludes definite conclusions.

The graphs in Figure 6 indicate that no further decline has occurred since 1969. The reduction of coliform concentration in 1974 and 1975 may be due partly to dilution by high stream flow or may be attributed to the use of the Membrane Filter coliform analysis instead of the previously used MPN analysis. Actual bacterial discharges to the stream, as determined by load, did not decline but rose with the high flows.

Additionally, coliform concentrations are similar in magnitude throughout the stream. Figure 6 shows that the annual coliform concentrations at the upper

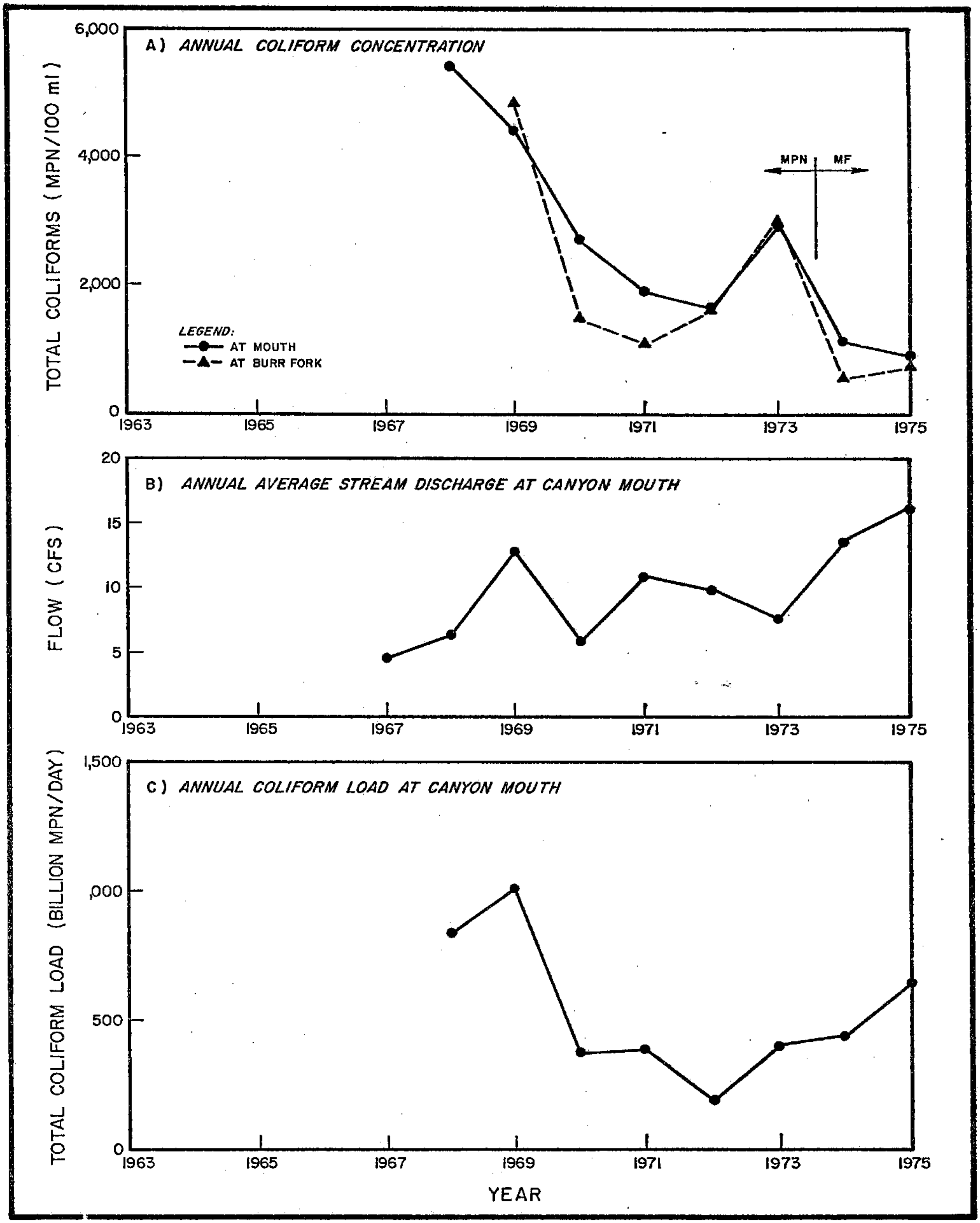


FIGURE 6
COLIFORM CONCENTRATION, LOAD AND DISCHARGE IN EMIGRATION CREEK

Emigration station below Burr Creek Fork are nearly the same as those at the mouth, even though the stream flow and coliform load at the upstream station are considerably less (no data on these items is available). Further, the average monthly coliform counts at the two stations are also very similar. Figures 7 (a) and (b) show the monthly coliform concentrations in upper and lower Emigration Creek respectively. Figure 8 summarizes Figure 7 to display the average monthly variations at the two stations from 1969 to 1973. Monthly concentrations at upper Emigration are similar except for greater winter concentrations and the depressed June-July concentrations caused by the early freezing and later snow melt at high elevations as illustrated in Figure 8 (c).

Total and fecal coliform concentrations as measured at 7 stations along Emigration Creek are shown in Figure 9. Total coliform increase somewhat between Burr Fork and EPA station EC-4, as is expected in June from Figure 8. Total coliform otherwise remain relatively uniform. Fecal coliform, however, increase between EPA stations EC-4 and EC-5 indicating the major loadings of fecal coliforms probably occur between Kelvin Grove and Lost Camp where the canyon is very narrow. This suggests a large number of inadequate septic tank facilities in this region. The decline of fecal coliforms beyond station 5 is due either to dilution by a distributed source of water along the stream not containing fecal coliforms, or to bacterial die-off.

The somewhat uniform stream concentrations seem to be related to the uniform distribution of developments along the stream. Some measure of the density of development per mile of stream may relate coliform levels to density of development. The following table presents statistical information concerning the developments above each station and the stream load (expressed as a concentration) per unit of development. The number of developed areas per mile above upper Emigration is

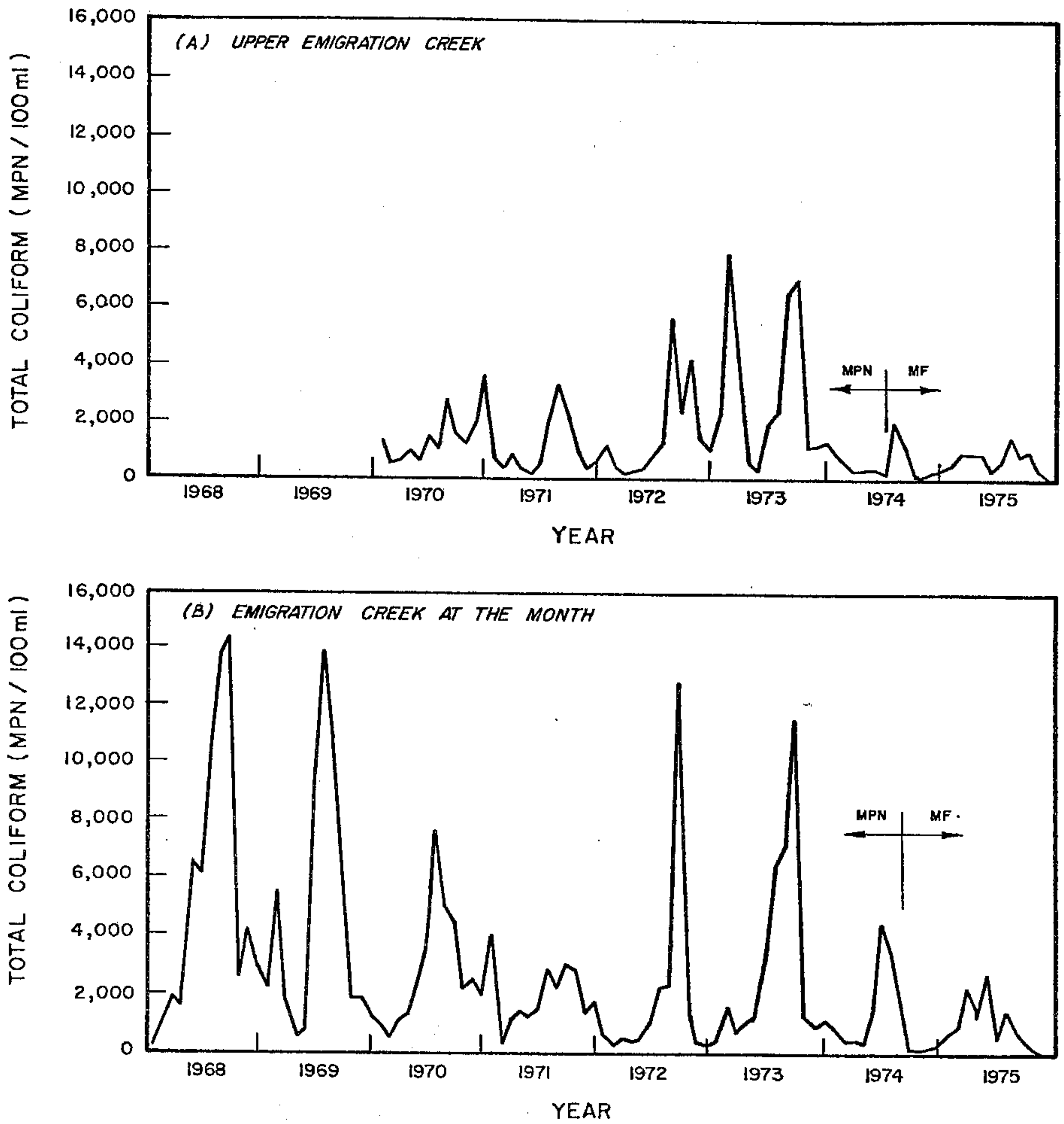


FIGURE 7

EMIGRATION CREEK TOTAL COLIFORM CONCENTRATIONS

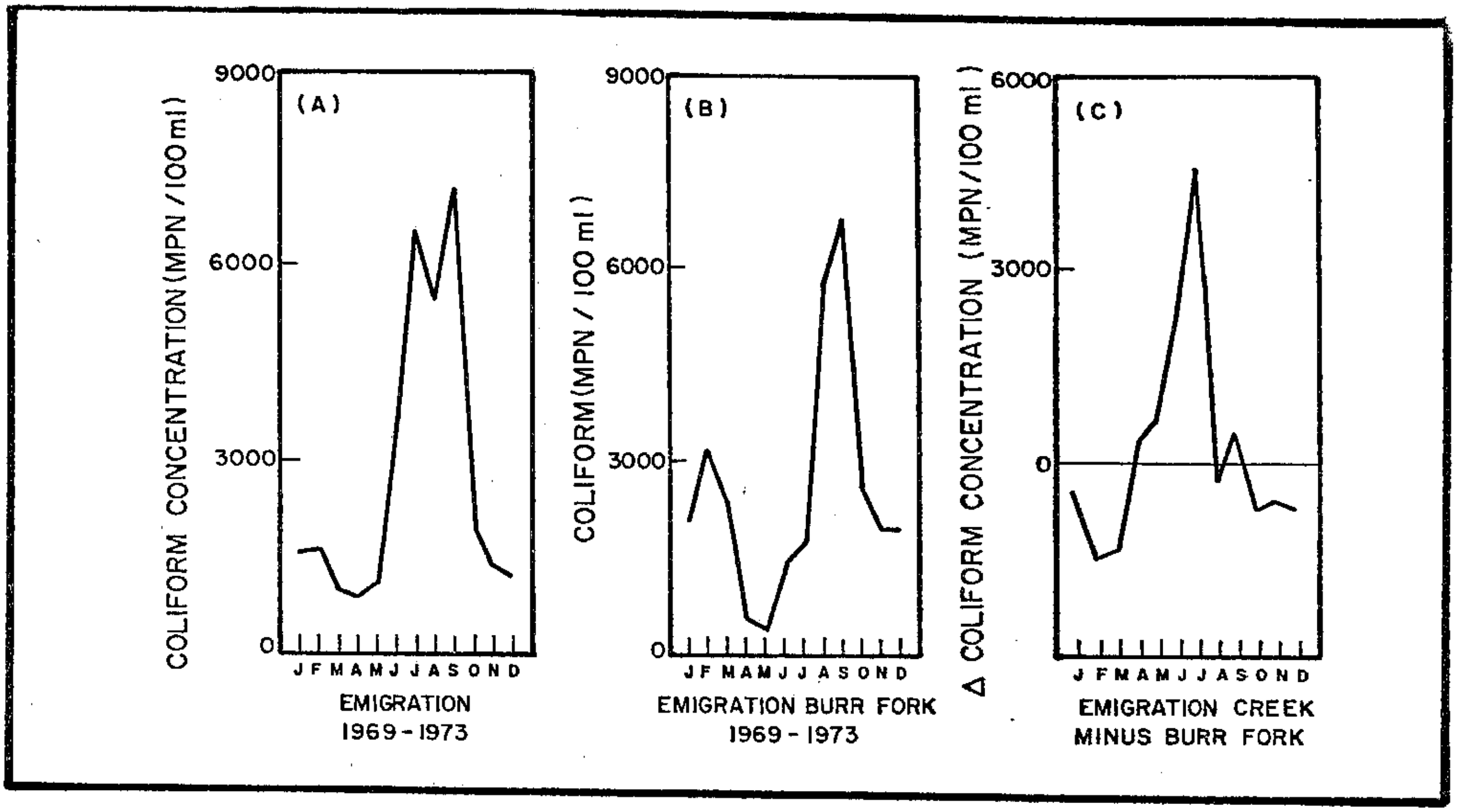


FIGURE 8

COMPARISON OF AVERAGE MONTHLY COLIFORM CONCENTRATIONS AT UPPER AND LOWER EMIGRATION CREEK

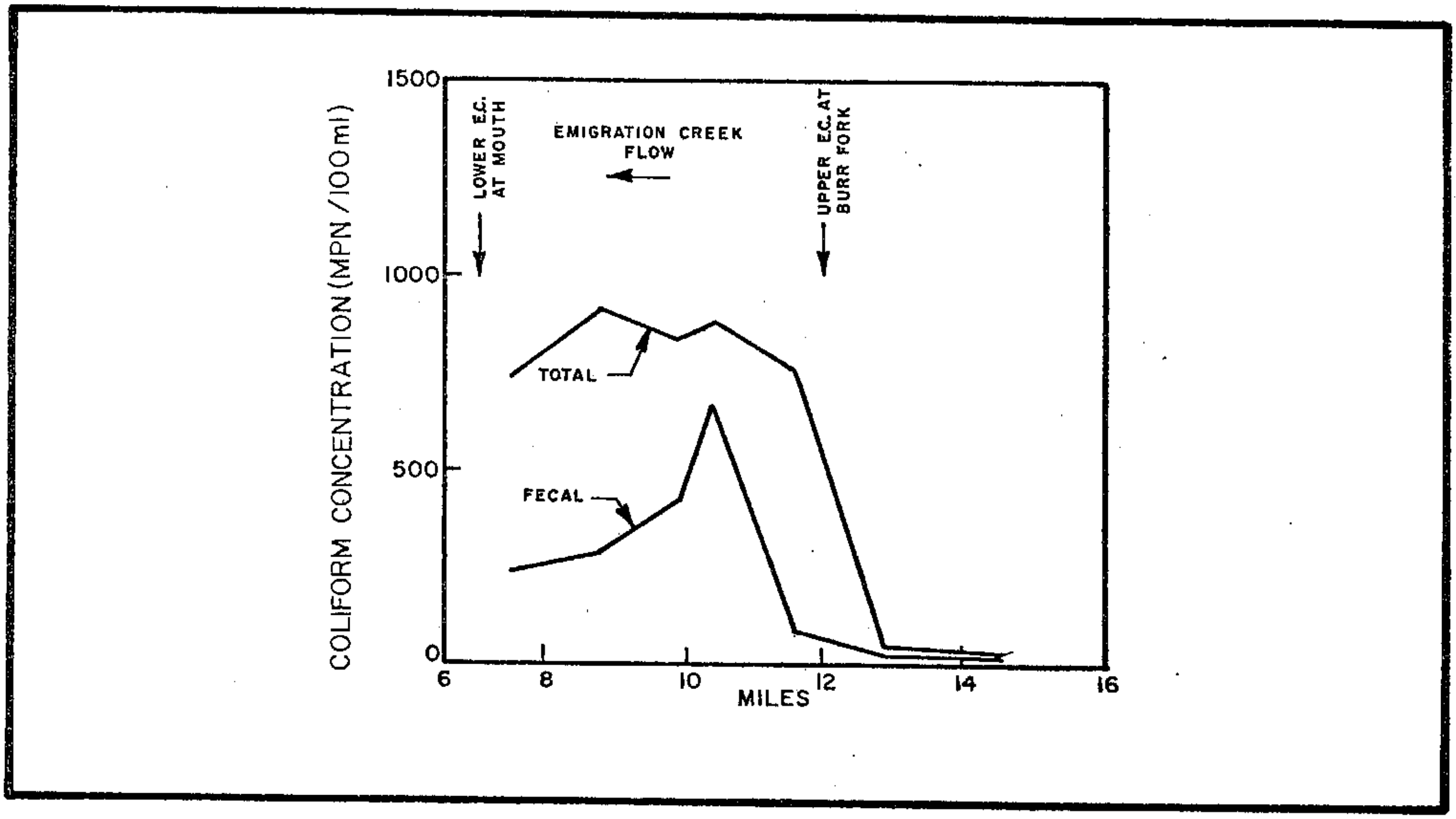


FIGURE 9

TOTAL COLIFORMS IN EMIGRATION CREEK - JUNE 1972 less than Emigration Creek in general, but the cabin density is greater. Neither coliform concentration as related to cabin

TABLE VII

EMIGRATION CREEK COLIFORM LEVELS RELATED TO RESIDENTIAL USE

	Stream miles	Cabins	Developed Acres	Cabins mile	Developed Acre miles	Avg. Annual Coliform '69-'73 MPN/100	Coliform /Cabin/mi.	Coliform /Acre/mi.
EC Mouth	8	238	186	30	23	2898	97	126
EC Upper	2.5	103	40	41	16	2773	68	173

density (cabins/mi.) or development density (developed acres/mi.) is a suitable index in itself. Some combination of both indexes might prove to be more satisfactory but is unwarranted considering the available data.

3. Conclusions and Summary

The following conclusions can be drawn concerning Emigration Creek.

(1) Emigration Canyon is the most heavily used canyon and has the greatest pollution levels as measured by coliform concentration.

(2) Pollution appears to be related to the heavy residential use and the poor disposal of sanitary waste and household wastes.

(3) Coliform levels dropped by at least 50 percent after 1968-1969, but have remained constant throughout the 1970's. The decrease may have been due to the improved wastewater management programs undertaken by the county.

(4) Presently, monthly concentrations can be expected to range from 1000 to 7000 MPN/100 ml, averaging 2900.

(5) Coliform concentrations are slightly affected by variations in annual flow.

(6) Total coliform concentrations (not loads) are similar at the mouth and points upstream, i.e., influent water appears to have the same total coliform characteristics at all points.

(7) A large amount of fecal coliforms enter Emigration Creek between Kelvin Grove and Lost Camp, probably from inadequate septic facilities in this narrow reach of the stream.

(8) Unit annual coliform loads for Emigration Canyon with septic tanks on steep slopes near the stream bank is, perhaps, 80 MPN/100 ml cabin/mile; i.e., on the average, the coliform concentration of Emigration Creek is increased by 80 MPN/100 ml by each cabin per mile of creek.

E. PARLEYS CANYON

1. Present Use

Parleys Canyon is a very densely developed and heavily traveled canyon. However, most of the length of Parleys Creek is a culvert beneath Interstate Highway 80. Parleys Creek enters the culvert below Salt Lake City Water Department's (SLCWD) water intake and treatment plant below Mountain Del Reservoir.

Above the reservoir, a few camp sites and picnic facilities are served by I-80 and another connecting road with Emigration Canyon. The 1973 annual traffic volume on I-80 which follows the watershed for several miles was 11,573 vehicles per day.

2. Water Quality

Water quality at the SLCWD's water intake is quite good, averaging about 25 MPN/100 ml from 1970-1973 (Figure 11). Because the retention time in Mountain Del Reservoir is large, the effects of recreational use in the upper watershed are modified and the quality records actually represent the reservoir quality rather than the canyons.

As shown in Figure 10 (using 1970-1973 monthly average data) coliform concentrations are low throughout the summer and fall. The peak occurs between January and May.

F. MILL CREEK CANYON

1. Present and Historical Land Use

Mill Creek Canyon is a heavily used recreational and summer residential canyon. The primary recreational use is picnicking. There are more than 1900 designated picnic spaces (more than any other canyon) in numerous picnic sites along the creek. The average daily traffic (ADT) in 1973 was 1300 vehicles per day.

The canyon is similar to Emigration Canyon in that it has a similar type of wastewater management program and is not presently used as a public water supply. While this canyon is not as steep-walled or narrow as Emigration, the topography and soil characteristics may not be favorable for septic disposal systems. The level of development of Mill Creek Canyon is one-third that of Emigration in number of developed acres (54), number of cabins (72+), and number of developed acres per mile of stream (9). There is no year around residential use in Mill Creek Canyon as there is in Emigration.

Typically, wastewater has been disposed of through septic tanks and underground drain fields. However, in the late 1960's and early 1970's (exact date unknown) when the poor quality water of Mill Creek was traced to the poor wastewater management program, controls were established to improve the waste disposal methods utilized. Before this program was instituted, many inadequate waste

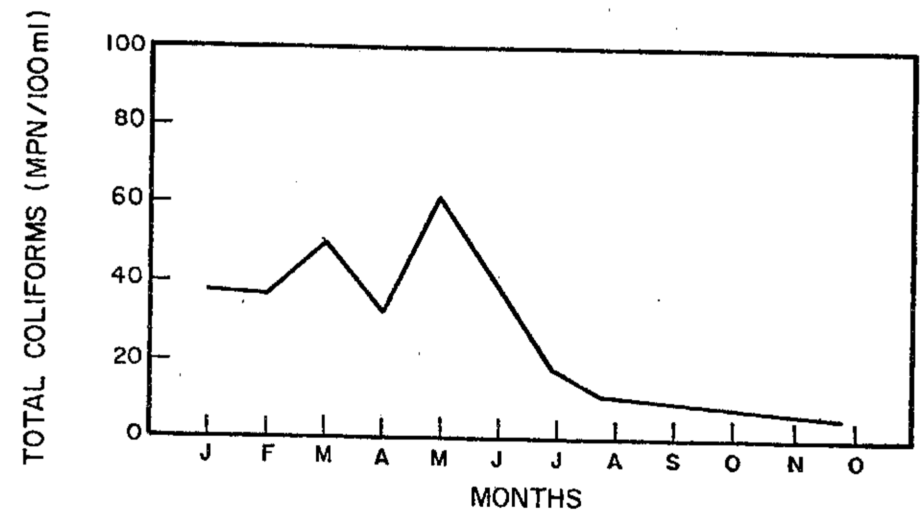


FIGURE-10

MONTHLY AVERAGE TOTAL COLIFORM CONCENTRATION IN PARLEY'S CREEK, 1970-1973 DATA

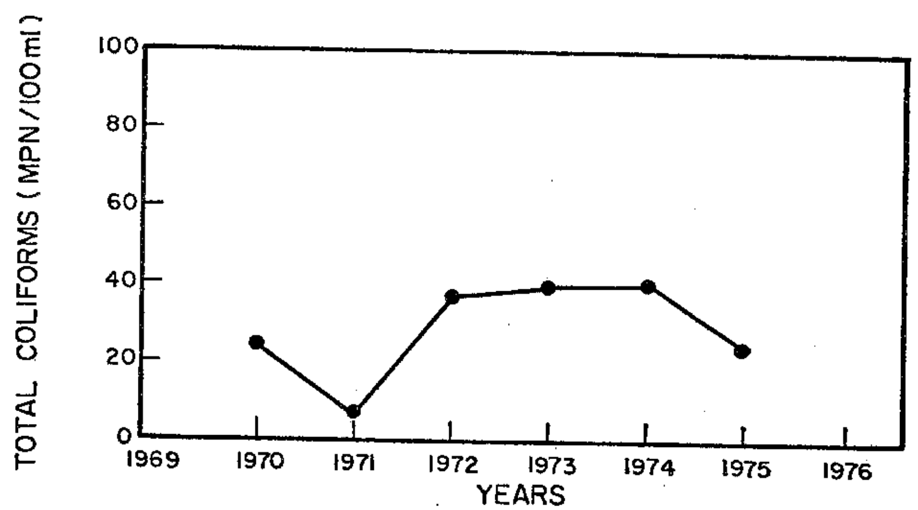


FIGURE 11

ANNUAL AVERAGE TOTAL COLIFORM CONCENTRATION IN PARLEY'S CREEK, 1970-1975 disposal methods had developed, including poorly maintained drainage fields and direct toilet discharges to the stream. These have been corrected and the level of patrol and inspection upgraded.

The many picnic grounds of Mill Creek Canyon are extensively used throughout the summer. During 1972 and 1973, some picnic grounds were closed for reforestation.

2. Water Quality

From 1967 through 1971 annual coliform concentrations were fairly high averaging 750 MPN/100 ml (Figure 12). In 1972 concentrations dropped markedly to about 150 MPN/100 ml and remained low.

Coliform pollution in Mill Creek is evidently from cabin waste and picnic use. As in Emigration Creek, malfunctioning septic systems and a poorly controlled wastewater control program were the probable cause of the excessive concentrations prior to 1972. The drop in early 1972 may be associated with improved management methods; however, there is no data to confirm this. A similar drop occurring in Emigration Canyon in 1970 was also stated, without documentation, to have possibly been caused by the same types of improvements in watershed management methods. Why Mill Creek responded two years after Emigration Creek is unknown.

Figure 13 shows average monthly coliform concentrations and the hydrograph period of 1967-1974. The change in canyon quality just prior to 1972 is clearly shown. In the first period, 1967-1971, coliform levels rise with rising seasonal stream flow and peak to 2000 MPN/100 ml in July or August in contrast to Emigration where concentrations rise as seasonal flow decreases. Concentrations in all but one winter (1969-1970) are very low (less than 100 MPN/100 ml) compared to Emigration Creek where cabins are used year around.

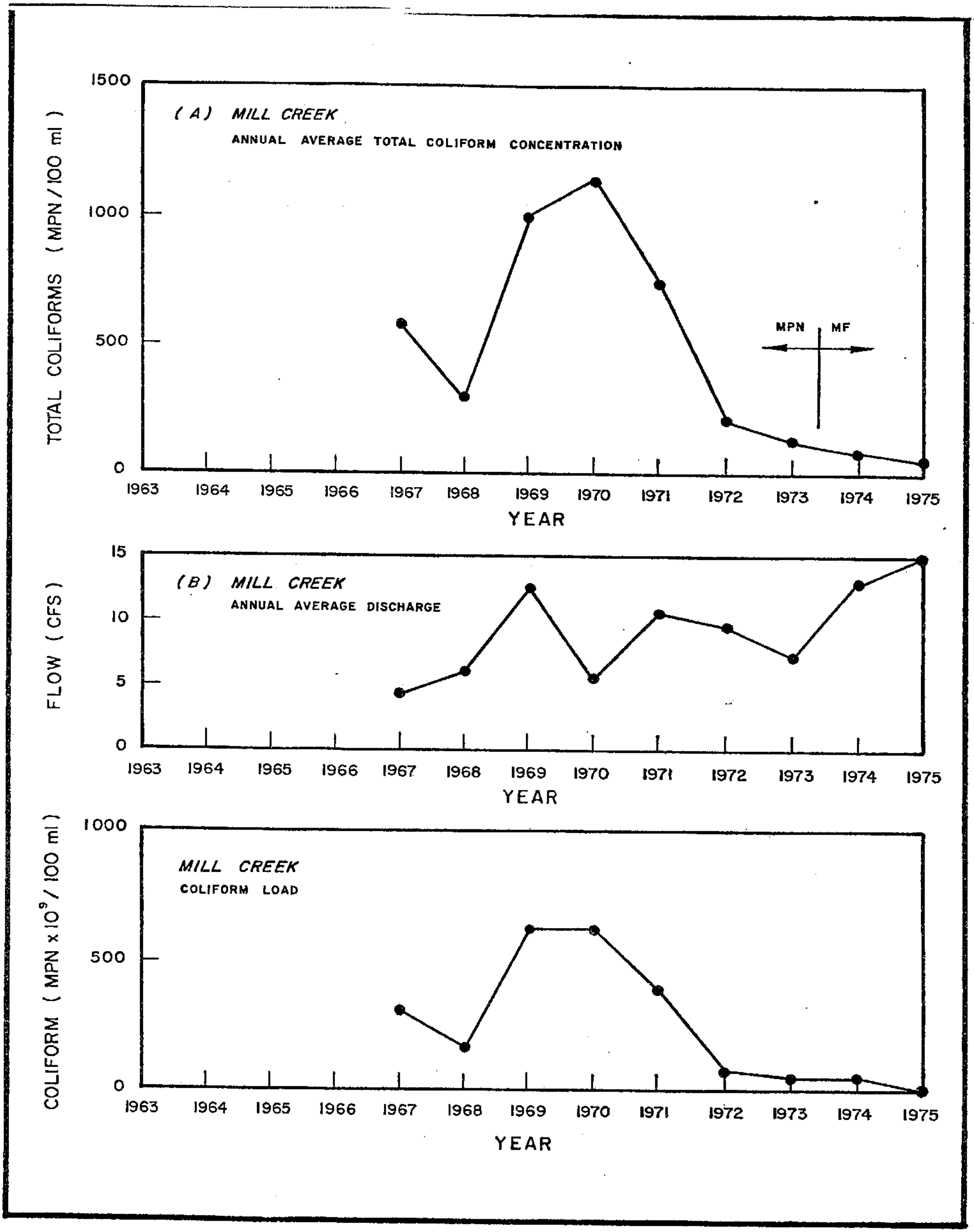
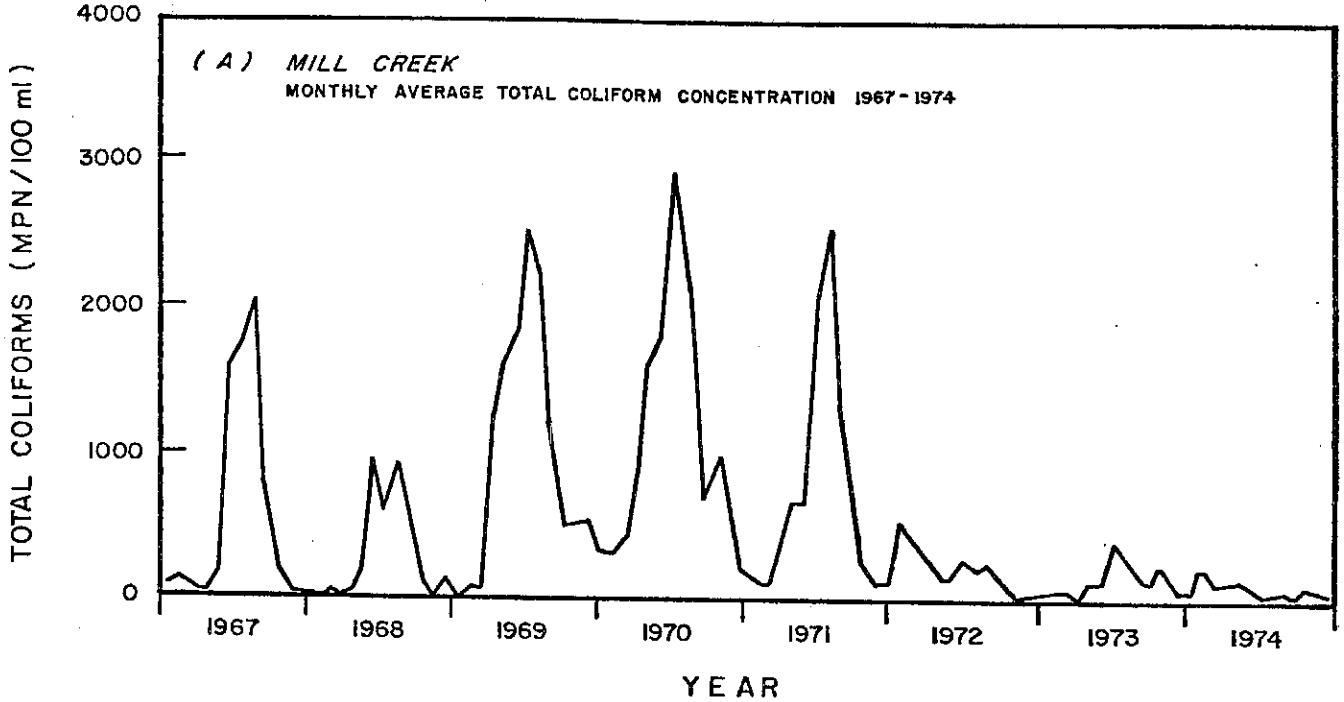


FIGURE 12

COLIFORM CONCENTRATION, LOAD, AND FLOW AT MOUTH OF MILL CREEK



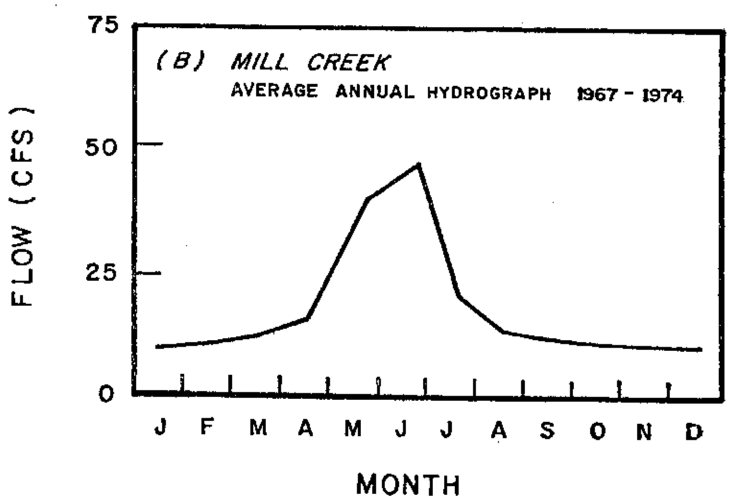


FIGURE 13
MILL CREEK - MONTHLY AVERAGE TOTAL COLIFORM CONCENTRATIONS AND AVERAGE ANNUAL HYDROGRAPH, 1967 - 1974

After the implementation of control measures, summer coliform levels dropped to one-third or about 200 MPN/100 ml. Winter values remained the same or only slightly lower. The possible sources of man-made pollution in Mill Creek Canyon are picnickers and scattered residences. Coliform concentrations resulting from picnic use in City Creek Canyon have been found to be in this same range or slightly less. Thus, with the increased picnic density (2 to 6 times that of City Creek), it is conceivable that all pollution currently comes from picnic use. More likely, however, the pollution originates from an unknown mix of the two sources. Since the watershed appears to be in a transition from the high and erratic monthly spikes of pollution to a more regular pattern, additional data must be gathered before more definite conclusions can be reached.

3. Conclusions and Summary

The following conclusions can be drawn concerning pollution in Mill Creek.

(1) Annual average coliform levels presently range from 100 to 200 MPN/100 ml with monthly variations from 25 to 200 MPN/100 ml.

(2) Currently, the major source of pollution is from picnic use and residential wastewater. However, the proportion due to the two sources is undetermined. Picnickers may contribute the majority of the pollutants.

(3) Prior to 1972, coliform concentrations averaged near 1000 and peaked to 5000 MPN/100 ml. The source was improper disposal of residential wastes resulting from a poor watershed management program.

(4) Coliform concentrations dropped by two-thirds in early 1972 and remained consistently "low". The probable cause of the drop was an improvement in watershed management practices, especially with reference to improperly operating residential waste disposal systems.

(5) Coliform loads are related to runoff from the watershed; concentrations change little (if any) in wet and dry years. Thus, loads are related to deposits on and in the shallow portions of the watershed, not from direct discharge to the stream.

G. BIG COTTONWOOD

1. Present and Historical Usage

Big Cottonwood Canyon is a heavily used recreational and residential canyon. It receives perhaps the largest number of year-round recreational visitors of all the canyons. The canyon is intensely used throughout the year with peak use (as determined by the average daily traffic) in July and February. Summer activities include an intensive amount of picnicking, hiking, fishing, etc. Summer Average Daily Traffic (ADT) has averaged about 2500 vehicles per day with July peaks to over 3500 (monthly average). There are 440 cabins and more than 1500 picnic sites in the canyon.

Winter activities include skiing at Brighton and Solitude (until closed in 1972), hiking, and cabin visits. The average winter (November-April) ADT is just under 2000 vehicles per day (365,000 vehicles per season) with peaks to almost 2500. The majority of these winter visitors, though, are engaged in a winter activity other an skiing, since the number of 1974 skier visits to Big Cottonwood was reported to be 100,000 persons per season, while the winter vehicles carried 300,000 persons into the canyon (based on 2 persons per vehicle and 20% commercial traffic). Skier use of Big Cottonwood is primarily day use. The skier capacity is represented by parking for 1350 autos and a limited lodging capacity (135 persons) for overnight skiers.

Residential use of Big Cottonwood is very large. However, as in the other canyons used by SLCWD for domestic water supply, all sanitary waste is stored in vaults or holding tanks. Kitchen and shower waste is sent to a septic tank system. Nearly all residential area soils are classified as having conditions unsuitable for septic tanks.

Public use of this canyon began in 1893 when the Brighton Hotel opened. For many years the Brighton Ski Resort was the primary skiing facility in the region. Table VIII shows the history of development. Reportedly, major skier activity rose dramatically in 1947 and again in 1954. But as is shown in Figure 14, the increase in winter use has continued upward since 1955 when the winter ADT rose from 300 to almost 2000. Although total winter use appears to have leveled off since 1970, skier use is increasing. However, skier use may decline somewhat in the future due to the opening of Snowbird in Little Cottonwood Canyon and the closing of the Solitude Ski Resort in 1974. In general, total use, and especially summer use of the canyon has risen gradually since 1955 at approximately 70 more vehicles per day each year. If this trend is extrapolated back to zero, it shows modern day growth began in the mid-1940's which corresponds to the time unofficially reported by Salt Lake City residences as the beginning of the growth period.

2. Water Quality

Water quality as measured by coliform concentrations in this canyon is good. Average annual concentrations are below 100 MPN/100 ml and monthly summer peaks are usually below 150 MPN/100 ml. Lowest concentrations are usually reached in January or February while the highest concentrations occur in summer after the spring runoff.

TABLE VIII

HISTORY OF DEVELOPMENT IN BIG COTTONWOOD CANYON*

1893-4	Construct Brighton Hotel
1936	Construct tee bar ski lifts
1934-35	Construct more tee bar ski lifts
1938	Private enterprise took over
1941	Alpine Lodge sold
1946-7	First chairlifts built (Brighton Corp)
1952 or 53	Alpine Lodge burned down
1954	First double chairlifts built
1958	First eating facility constructed
1958	Mount Logistic Manner built
1959	Double chairlift added
1963	Purchased single chairlift
1969	Double chairlift built
1973	Converted single to double chairlift
1974	Solitude closed (last season: 1973-74)

*Major Source: Dean Jensen, Brighton Corp.

The relatively high quality of water at the mouth of this canyon reflects primarily the good wastewater management program, and secondarily, the firm granitic rock of Big and Little Cottonwood Canyons. It is evident that the vaulting practice for sanitary waste is far superior to the septic tanks and drain fields of Mill and Emigration Canyons where coliforms are an order of magnitude greater at lower residential densities.

As in the other canyons where records exist back to the 1930's, present coliform levels are considerably higher than the early years. Figure 14 (a) shows the degradation in quality that occurred rather abruptly at the end of World War II corresponding to the reported significant increase in canyon use. Other than this, the general trend of pollution does not correspond to known changes in land use or intensity of use. In fact, at times, the annual pollution trend appears to run counter to the intensity of use. Nevertheless, as will be pointed out, the characteristic coliform concentrations are such that changes in pollution can be linked to changes in land use.

The annual coliform concentrations of Figure 14 appear to be very erratic, alternating between 30 and 150 MPN/100 ml annually. Average winter concentrations from November through April are shown to be more consistent and perhaps a better indication of the ambient quality of the watershed. Changes in the availability of erodible material, such as caused by the destruction of vegetation through construction and picnicking, should be manifested in the winter coliform levels. Additionally, winter bacterial levels should reflect increased winter usage. Figure 14 shows winter concentrations rising in the early 1950's and again in the 1960's. The gradual increase in the winter appears to be closely associated with increasing use intensity.

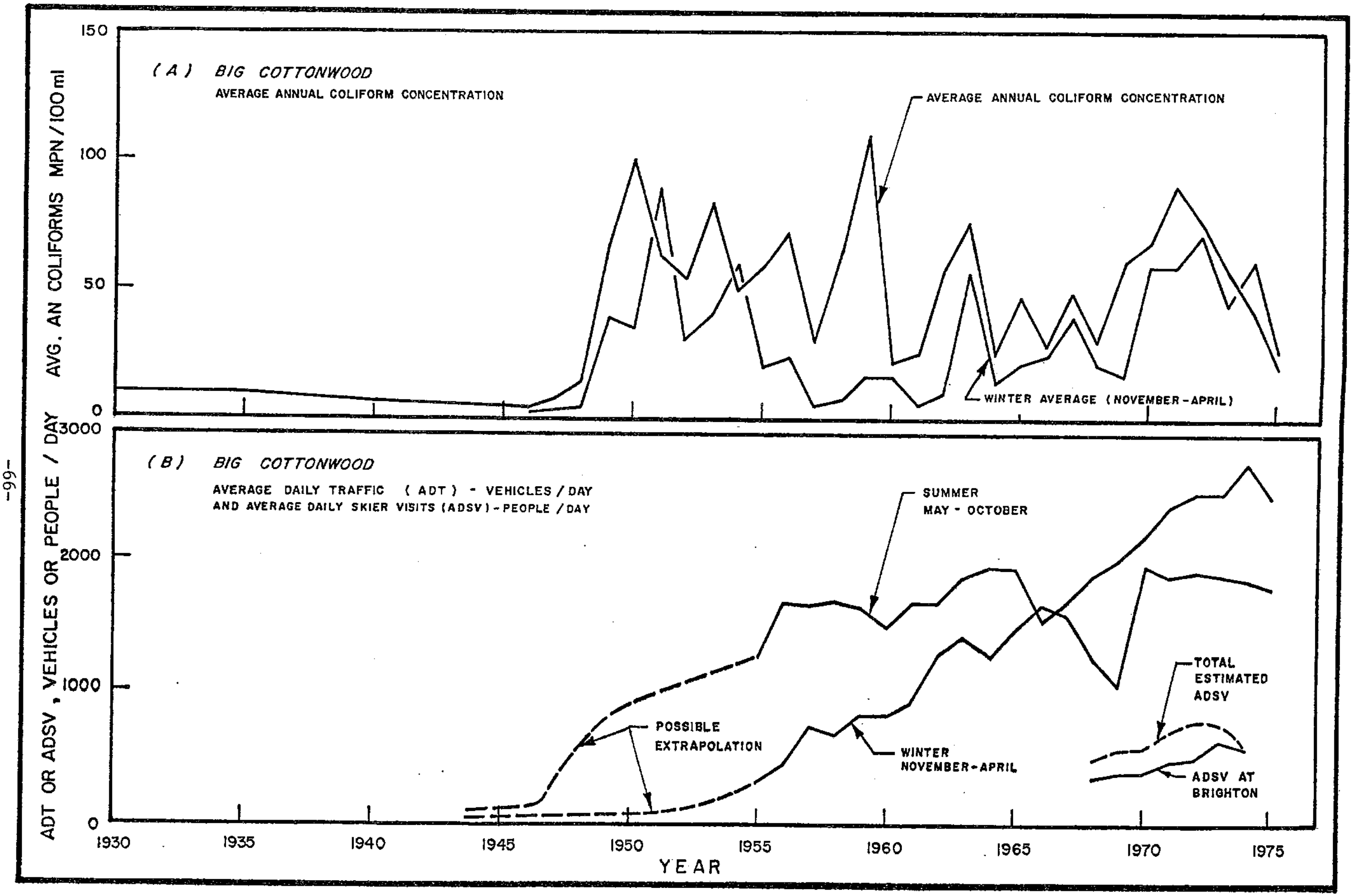


FIGURE 14

ANNUAL WATER QUALITY AND TRAFFIC IN BIG COTTONWOOD CANYON

The winter average coliform concentration from the 1950's on (Figure 14 (a)) generally reflects the increased usage of Big Cottonwood Canyon shown in Figure 14 (b). However, it is difficult to say which, if any, of the uses; 1) winter use, 2) summer use, or 3) skiers is primarily responsible for general degradation in quality as shown by the winter coliform concentrations.

Additional influences concerning land use can be made by observing particular characteristics of Figure 15 which presents monthly average coliform concentrations from 1930 to 1975.

Prior to 1947, coliform concentrations were quite low. Monthly concentrations did not exceed 20 MPN/100 ml and usually dropped to 1 or 2 MPN/100 ml in winter. This level can be considered close to "natural" conditions because of the low use of the canyon. Monthly records for 1930, 1935, and 1940 show less consistency between the years than exists in City Creek, perhaps reflecting the minor canyon activity throughout this period.

From 1947-1949, concentrations increased sharply with a pattern nearly identical to those of City Creek, perhaps responding to a similar increase in use by picnickers and day visitors. As in City Creek, 1949 pollution patterns are erratic showing a fairly high winter base and a summer peak above 200 MPN/100 ml. The water quality in the late 1940's and early 1950's resembled the water quality of City Creek which at the time was affected by picnickers. However, Big Cottonwood water quality during this period cannot be directly related to land use because of a lack of data.

During the latter half of the 1950's and early 1960's, coliform concentrations followed a fairly regular pattern, altered by distinct events in certain years. In this period, coliforms were approximately 4 times greater than "normal", ranging

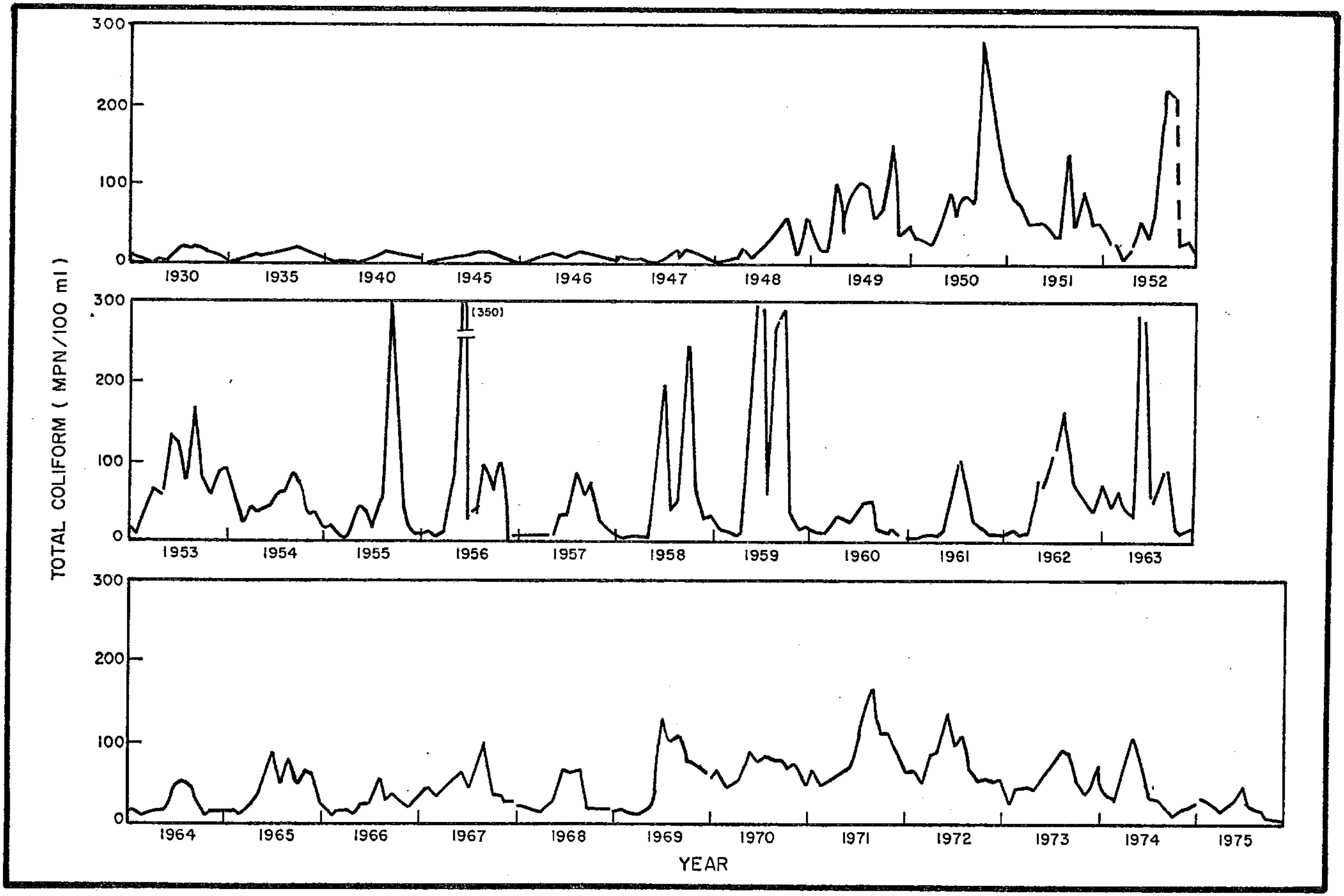


FIGURE 15
BIG COTTONWOOD CREEK
MONTHLY AVERAGE TOTAL COLIFORM CONCENTRATIONS 1930-1975

from about 8 to 80 MPN/100 ml between winter and late summer respectively. However, the relatively low coliform counts are overwhelmed in 1955, 1956, 1958, 1959, and 1963 by what appears to be problems with septic waste disposal systems or leaky waste storage vaults. The very high summer spikes in these years have been found in the other creeks to be due to residential waste disposal systems. Likewise, the period from spring 1962 to perhpas fall of 1963 appears to be characteristic of construction as described for City Creek and Little Cottonwood Creek.

In the latter part of the 1960's, bacterial concentrations rose gradually in the winter while the summer concentrations maintained approximately the same shape and intensity. Thus, it again appears the source of pollution is from an activity affecting the stream only in the winter months.

In the 1970's water quality improved. Whether this is 1) an actual improvement in quality caused by the reported improvement in water quality management methods such as the exclusion of dogs, or 2) an adjustment from unusually high concentrations observed in 1969-1971 is unknown. Winter concentrations have leveled off in the 1970's consistent with the leveling off of the winter ADT.

An analysis of coliform concentrations along Big Cottonwood from 1968 through early 1974 shows spatial uniformity along the stream in the winter. Figure 16 shows the summer and winter concentrations at 5 stations on Big Cottonwood. The stations are located on the map in Figure 2 and are:

FIGURE CODE	STATION NAME
M	Mouth
1	Storm Mountain
2	Reynolds Flank
3	Silver Fork Lodge
4	Brighton

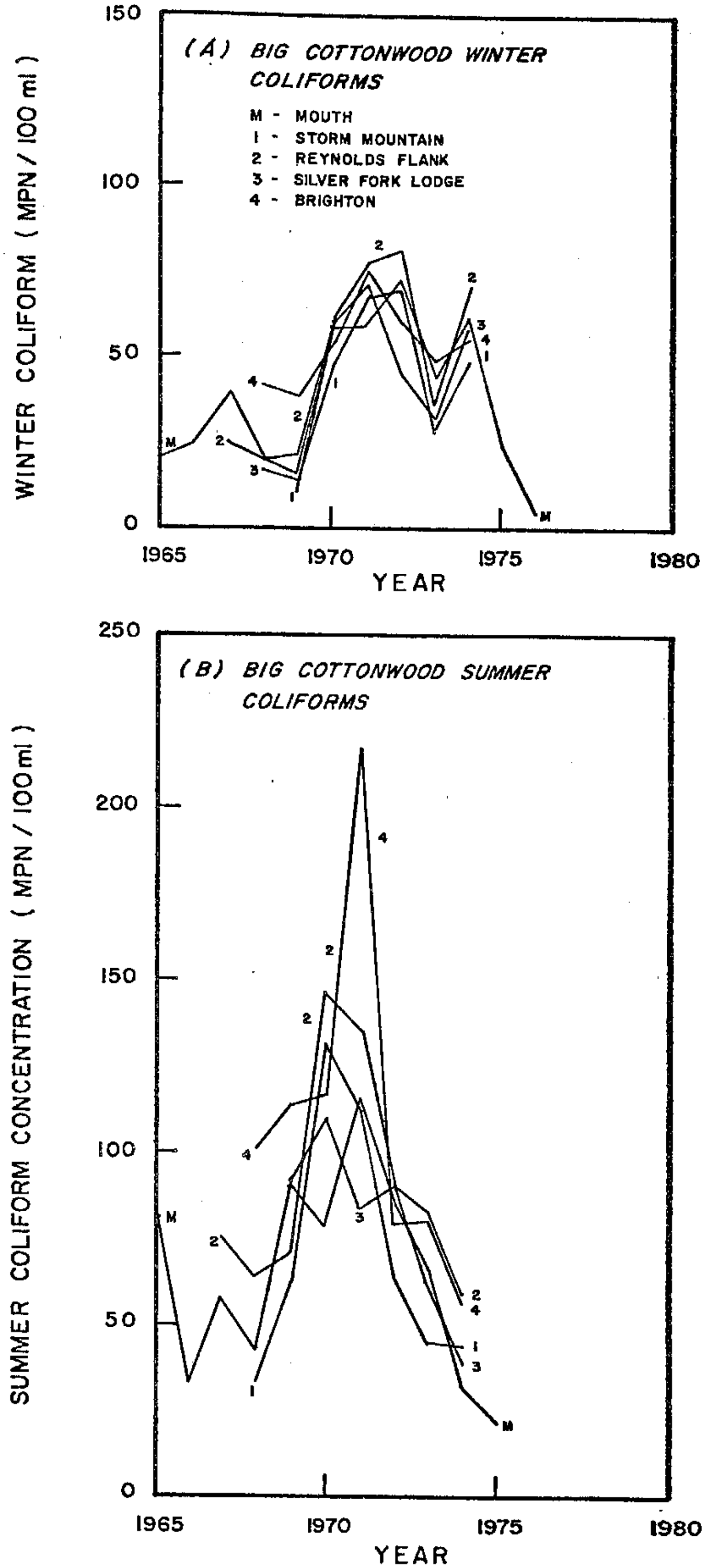


FIGURE 16

SUMMER AND WINTER COLIFORMS AT 5 STATIONS ALONG BIG COTTONWOOD CREEK

All stations show very close agreement except perhaps the station at Brighton which is ocassionally slightly higher. By implication, either the stream is receiving uniform pollutant loads, or tributary water is of the same concentration throughout. Since developed areas are not uniformly distributed along the stream, the data provided by the 5 Big Cottonwood stations suggest that there is no correlation between stream pollution and developed regions of Big Cottonwood Canyon. However, camp sites are more evenly distributed, and this may be the source of stream pollution.

3. Conclusions and Summary

The following conclusions can be drawn concerning water quality and land use in Big Cottonwood Canyon.

(1) Concentrations in "natural" conditions range from approximately 1 or 2 to 15 or 20 MPN/100 ml, and peak distinctly in late summer.

(2) Coliform concentrations presently range from apprxoimately 25 to 100 MPN/100 ml each year with an annual average of about 50 MPN/100 ml. Insufficient data are available to evaluate current trends.

(3) Coliform concentrations began to rise in 1947 when the first intensive use of the canyons was reported. Apparently picnic users caused concentrations to increase to an annual average of about 150 MPN/100 ml during the next several years.

(4) In the second half of the 1950's and 1960's coliform concentrations were typically low, regular, and approximately 4 times the range of natural values; i.e., from 8 to 80 MPN/100 ml. However, during this period, several years with obvious residential waste loads or construction loads are apparent.

(5) Beginning in 1960, winter coliform concentrations increased over a ten year period corresponding to an increase in winter average daily traffic (ADT) above 1000 vehicles/day. In the 1970's the winter bacterial level has been constant as has the winter ADT.

H. LITTLE COTTONWOOD

1. Land Use

Little Cottonwood Canyon is utilized primarily for recreational purposes throughout the year. It receives the heaviest recreational use of all canyons. Summer activities include an intensive use of the back country including hiking, and rock climbing, and considerable camping in two campsites. No picnic sites are available. Summer recreational use as measured by average daily traffic (ADT) is on the same order as Big Cottonwood Canyon. Winter activities include back country use for cross country skiing and rock climbing, with downhill skiing being the principal activity. The number of winter canyon visits is greater in Little Cottonwood than any other canyon. The two ski resorts, Alta and Snowbird, reported over half a million skier visits in 1974. The winter ADT is well over 3,000 vehicles per day. There are few cabins in this canyon, but the capacity for overnight guests is over 2,000.

Figure 17 shows the historical level of activity in Little Cottonwood Canyon since 1948 when traffic records were first kept. From 1955 to 1972 there was only a nominal increase in canyon use, and both summer and winter use remained about the same. Activity in this canyon was half that of Big Cottonwood. In 1972 the Snowbird Ski Resort opened, and the number of skier visits more than doubled in two years. Traffic increased accordingly. The ratio of average daily skier visits (six month average: ADSV = seasonal visits/six months) to the average

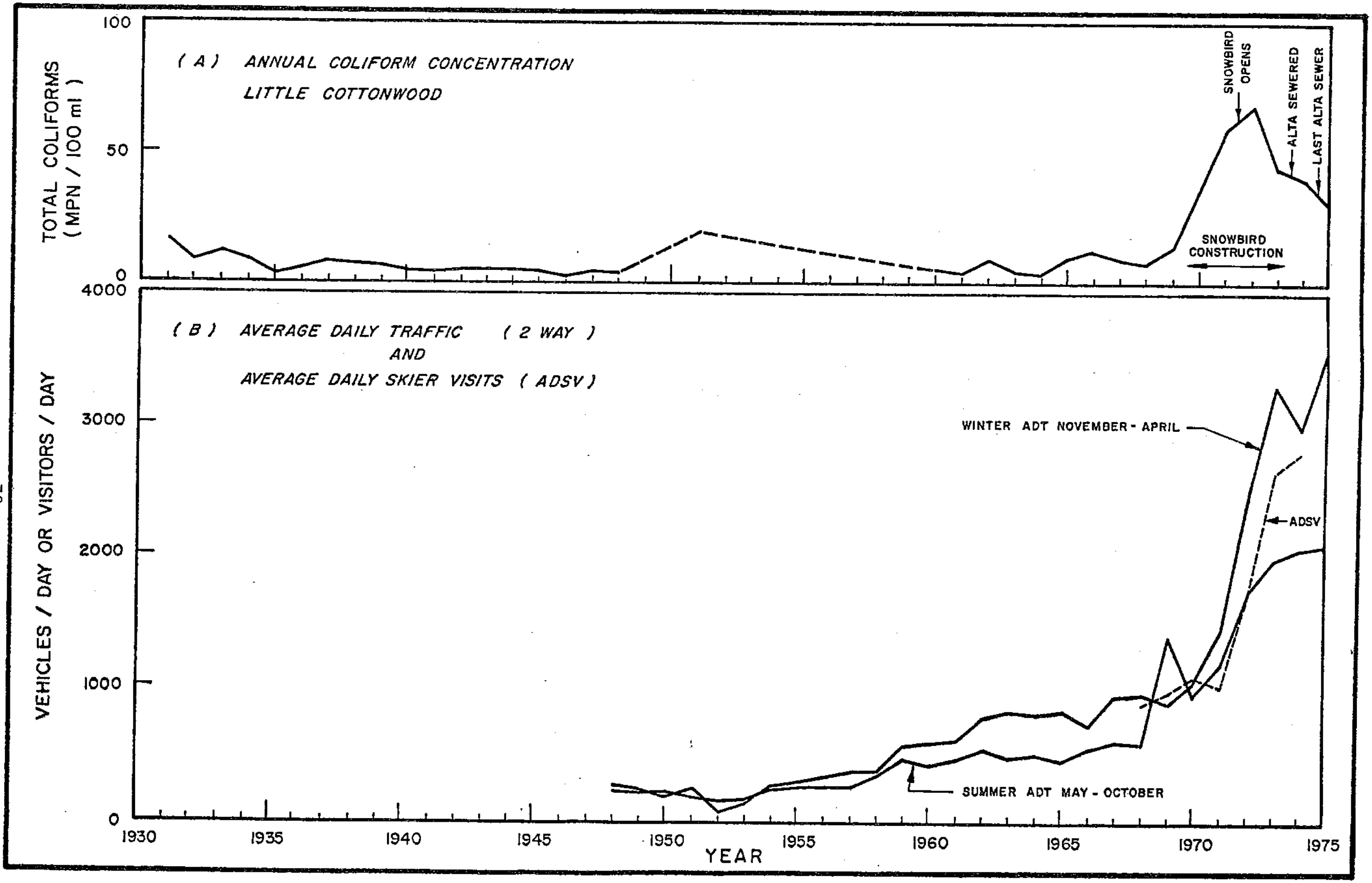


FIGURE 17

WATER QUALITY AND CANYON USE 1930 - 1975 IN LITTLE COTTONWOOD CREEK daily traffic is greater in Little Cottonwood than in Big Cottonwood, reflecting the skiing orientation of the winter visitors. The large increase in skier visits in 1972 was a result of the opening of the Snowbird Ski Resort facilities which were constructed from 1970-1973. A chronology of events concerning the construction of Snowbird is given in Table IX.

The water of Little Cottonwood is used by the Metropolitan Water Department for municipal supply. Consequently, wastewater disposal requirements within the canyon are at least as stringent as the other controlled canyons. For more than 30 years, the sanitary waste has been stored in holding tanks as in Big Cottonwood Canyon. However, in the early 1970's, a 15-inch pressure pipe sewer was installed from Alta to the mouth to carry sanitary, shower, kitchen and other household wastewater out of the canyon.

The sewer was completed in stages from 1971-1973. The first connections were made to Snowbird in the summer of 1971 before the Snowbird facilities were opened to the public. All but one unit of the Alta Resort was connected in the fall of 1972; the last Alta unit was completed in the summer of 1973. The Tanner's Flats campground was also connected during this period. Residences above Alta in Albion Basin (30 cabins) and Grizzly Ridge (6-8 cabins) have not been connected. These residences continue to operate on holding vaults.

2. Water Quality

Figure 17 shows the average annual water quality of Little Cottonwood Creek from 1930-1975. With some exceptions in the 1950's, average annual coliform concentrations were usually considerably below 10 MPN/100 ml from 1931-1968. The 1970's represent a period of changing land use and water quality in Little Cottonwood as the canyon became a major ski area. Water quality in the canyon

TABLE IX

APPROXIMATE CHRONOLOGY OF EVENTS AT SNOWBIRD*
AND LITTLE COTTONWOOD CANYON

June 1970	Began work on Lodge at Snowbird (Completed December, 1971)
August, September 1970	Lower Lift Terminal and Plaza (In operation December, 1971)
July 1971	Excavation began for Mid-Gad (Completed March, 1972)
August 1971	Grading for old employee housing begun (Where Iron Blosam now exists)
August 1971	Lift operator stations construction begun
Summer 1971	Canyon Sewer connected at Snowbird
December 1971	Lifts in operation
June 1972	Turra Murra (Began operation)
Summer 1972	Grading began at Gad I
Summer 1973	Chickadee Lift construction begun
July 1972	Iron Blosam Lodge begun
August 1972	Cliff excavation begun (Completed January, 1974)
Fall 1972	Canyon Sewer connected to all but one Alta unit
July 1973	Excavation for employee housing (Completed February, 1974)
Summer 1973	Canyon sewer connected to last Alta unit
Summers 1972, 1973, 1974	By-pass road construction (State Road)

*From Bonnett (1976)

is still in transition and it is difficult to predict the quality to be associated with the new intensity of use.

The Wasatch Canyons, and particularly Little Cottonwood Canyon, have been subjected to many water quality investigations in recent years because of the intensive use the canyons are receiving, and the desire to maintain the high quality of the streams. Several of these studies, Wilhelm[33] and Glenne[12], support a popular hypothesis that the intensive hiking, and especially skiing, activity of Little Cottonwood has lead to the rapid deterioration of quality in that canyon.

Although recreational activity very likely has a direct influence on the quality of Little Cottonwood, it is evident the major deterioration occurred as a result of the excavation, earth moving, and soil erosion during the construction of Snowbird. Figure 17 shows that the increase in annual coliform concentrations preceeds by 2 years the opening of Snowbird and the massive increase in winter or summer visitors. In addition, this figure implies that while recreational use and pollution levels both increased in the early 1970's, they were out of phase by at least 2 years. The result is that the quality deteriorated before the visitors arrived and improved at a time (1972-1973) when recreational activity was increasing rapidly. The construction of the Snowbird facility from 1970 to 1973 encompasses the period of poorest quality and offers a more obvious explanation of quality deterioration during the early 1970's.

A more detailed display of data in Figure 18 illustrates the same points. This figure shows the monthly average coliform concentrations and ADT from 1968 to 1975. When concentrations are compared with the monthly ADT, it is clear the increase in coliform preceeds the winter recreation increase by 18 months and the summer increase by 24 months.

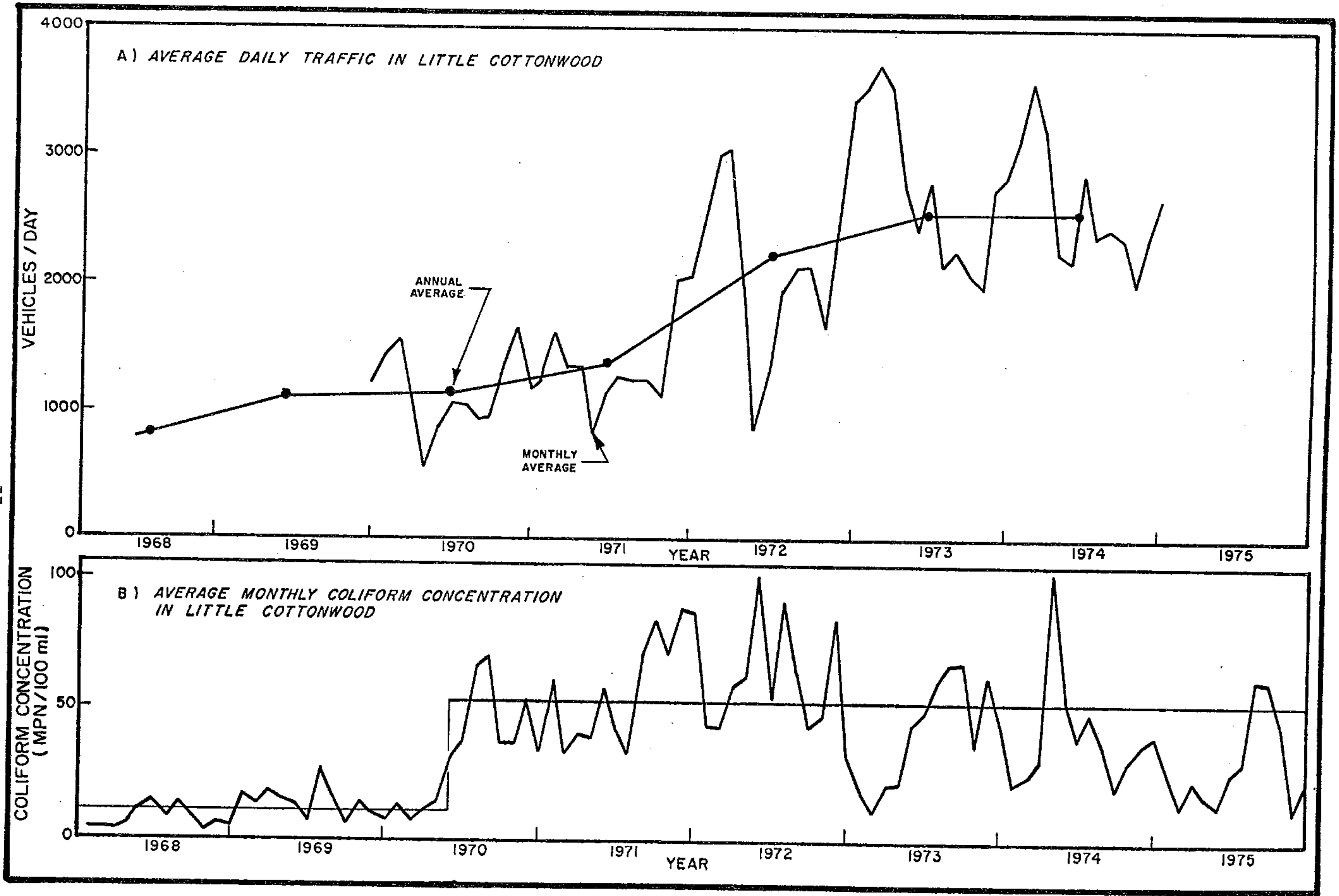


FIGURE 18
AVERAGE DAILY TRAFFIC AND COLIFORM CONCENTRATION
IN LITTLE COTTONWOOD CREEK AT THE MOUTH

The jump in coliforms in mid-1970 suggests at least 2 distinct periods exist. From 1960 to mid-1970 coliforms increase gradually around the linear regression line shown. During this period the data show a consistent monthly pattern typical of the "natural" conditions as found in this and other streams. That is, coliforms typically peak in July or August and reach a low in winter. Conditions changed in mid-1970 and concentrations became higher. The best fit linear regression line for the years from 1970-mid-1974 (not including the latter part of 1974 because of the switch to the Membrane Filter Analytical Method) is shown. From mid-1970 through 1974 concentrations are much higher in both the winter and summer and exhibit a pattern that is characteristic of that observed during construction in City Creek. Both lines have a regression coefficient better than 90%, according to Cortell[5].

Figure 19 suggests that major construction activity was paralleled by an increase in the annual average coliform concentration. From 1973 through 1975 coliforms apparently declined along with a decrease in construction activity. There is currently insufficient data to determine if this reduction represents 1) a partial and gradual recovery of the watershed after construction and that concentrations will continue to drop, 2) an artificial decline caused by the shift to the Membrane Filter Method in June 1974, or 3) the recovery of the watershed to a level reflecting the high intensity of use. If the 1973-1975 concentrations do represent the increased use intensity, then concentrations can be expected to rise gradually as use increases. It is also possible that all three explanations apply and the future of the water quality cannot be predicted.

Item 2 above is unlikely to be of major significance because independent records kept by MWD at the same location show a nearly identical trend. Figure 20 shows annual coliform concentrations as measured by 3 different methods; 1) the

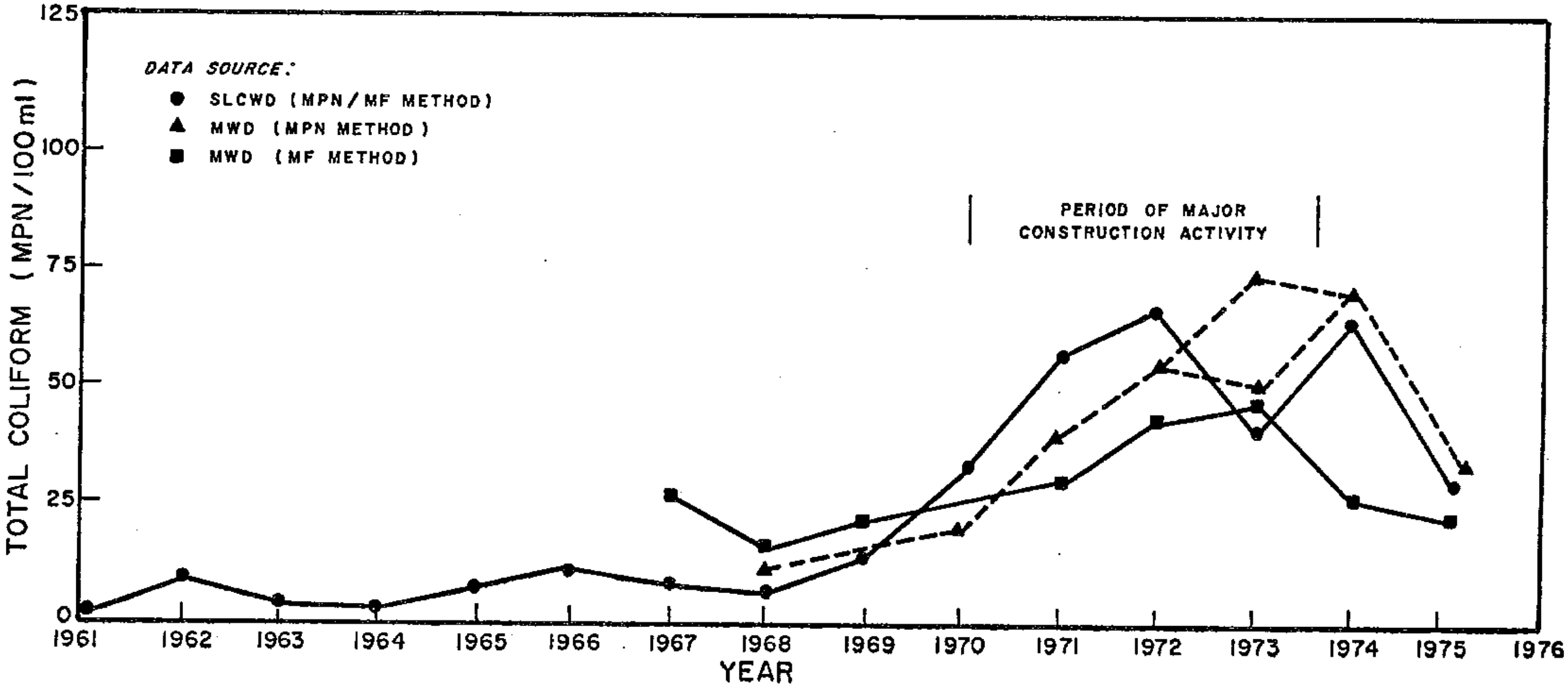


FIGURE 19
LITTLE COTTONWOOD - COMPARISON OF COLIFORM DATA FROM VARIOUS DATA SOURCES

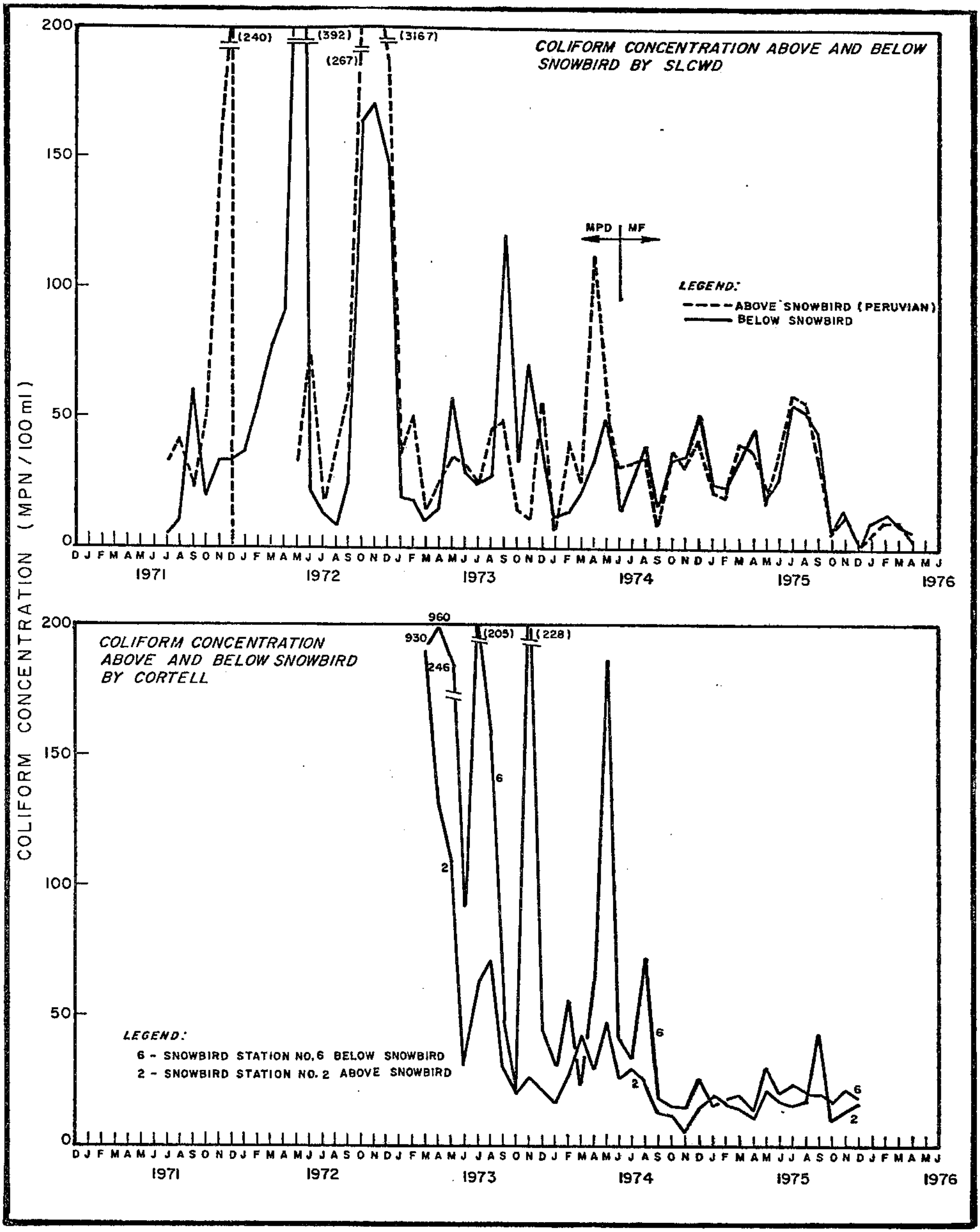


FIGURE 20
COLIFORM CONCENTRATIONS ABOVE AND BELOW SNOWBIRD

MF method by MWD, 2) the MPN method by MWD, 3) the MPN method by Cortell (Ford Laboratories), and 4) the MPN/MF method by CCHD for SLCWD. In the latter method, CCHD switched from the MPN to the MF method in June of 1974. All methods indicate quality has improved since 1973. The two methods exhibit nearly identical trends even though the numerical values differ by a factor of 4.8. The SLCWD and MWD stations are at the mouth at exactly the same location. The Cortell station (Snowbird #6) is just upstream of the mouth.

Additional evidence of the effect of the ski resort land usage on bacterial concentrations is found by observing the change in concentration throughout Snowbird. Figures 20 (a) and (b) show the change in bacterial water quality across the Snowbird property as measured by SLCWD (CCHD Laboratories) and Cortell and Associates (Ford Laboratories) respectively. Several interesting observations can be made by examining this figure and comparing it to the data in Figure 18.

First, water quality has improved in the early 1970's. All monitoring programs agree the coliform concentrations have declined at the mouth of the canyon and below and above Snowbird. Secondly, water quality from about 1973 on is essentially identical at the mouth, above and below Snowbird, indicating that the pollutant load is not local to one area (e.g., Snowbird) but is distributed along the stream. Thirdly, during the period of construction (until 1973), concentrations were less than half the numerical value, indicating the source of pollutants during this period was at or above Snowbird, and that they were diluted as they traveled to the mouth.

Interpretation of these plots suggests the hypothesis presented by Cortell and Associates[5] that construction was the major source of pollution during the 1970–1973 period is correct. Coliforms tied to the sediments and released at

Snowbird would be diluted 2.6 to 6.0 times on their travel to the mouth. More importantly, after the construction, seasonal and coliform levels dropped, and the numerical value of coliforms at each station was nearly identical. Thus, it appears the source of this pollutant cannot be from a single site but must be more uniformly distributed along the stream.

The source of this uniformly distributed bacterial source, which was not present prior to 1970, is probably tied to some recreational activity occurring throughout the canyons. Table V shows that apart from skiing, activity is devoted to visits to streams and roadside stops. Such activities include picnicking in non-designated areas and illicit camping by rock climbers and other groups in areas without proper sanitary facilities. Such activities may be the source of the present coliform loadings averaging 35 MPN/100 ml.

Similarly, a comparison of coliform plots from above and below Snowbird (Figure 20 (a) and (b)), indicates that there is no change in concentration. However, the incremental increase in stream flow through Snowbird is equal to that above Snowbird and Alta[12].

Additional evidence that Snowbird and Alta contribute equally to the coliform content of the stream is given in Figures 20 (a) and (b) which show coliform levels were high both below and above Snowbird during the construction period. Supposedly, no construction was occurring upstream of Snowbird. However, the high coliforms above Snowbird may have been from leaky sewage vault or poor shower waste disposal prior to the final connections of the sewer in 1972 and 1973.

3. Conclusions and Summary

The following conclusions can be drawn from the discussion of land use and water quality in Little Cottonwood Canyon.

(1) Natural coliform concentrations in Little Cottonwood Creek are extremely low, usually peaking to less than 10 MPN/100 ml in the summer and falling to near zero at the other times.

(2) Coliform concentrations remained quite low, near natural contitions, through mid-1970 despite increasing summer and winter recreational use. The maximum use is represented by about 1000 vehicles per day.

(3) Construction and earth moving activities at Snowbird from 1970-1973 were responsible for an order of magnitude increase in concentration at the mouth. However, near the construction site, concentrations were 2 to 3 times those at the mouth.

(4) Construction in summer appears to increase bacterial concentrations to a uniform level throughout the year.

(5) The water quality impact of skiers cannot be directly determined. However, their influence is small if any at all. Average monthly winter concentration from 10 to 20 MPN/100 ml (at the ski resorts) may be typical for the present usage representing half a million skier visits per year.

(6) Since canyon use is in transition, present coliform levels may change in the future. However, concentration with the present usage can be expected to range from 25 to 70 MPN/100 ml or less, typically peaking in the late summer.

(7) A source of pollution not present prior to 1970 exists and is not restricted to the region of the ski resorts. A probable cause is picnic and camping use in areas where no sanitary facilities are provided.

(8) The CCHD laboratory change from the Multiple Tube Method of analysis to the Membrane Filter Method in June 1974 does not fully explain the drop in reported coliforms after this period. The same trend is shown in results by three independent analyses.

V. SPECIFIC LAND USE IMPACTS

In the previous section, the relationship between water quality of each stream and its drainage land use characteristics was discussed. No special consideration was given to the water quality in other canyons with similar land use. In this chapter, the various land uses of the Wasatch Canyons will be evaluated independently to assess the impact of each use on the water quality as measured by total coliform. The uses evaluated are:

- Natural Conditions
- Construction
- Picnicking and Camping
- Hiking
- Winter Sports and Skiing
- Residential Use

The approach has been to analyze time periods in each canyon when specific land use activities have been predominant. In most cases, it was possible to isolate the canyon's use activity or to interrelate several uses in order to make definitive statements concerning the impact of each activity. However, in a few cases with the data base available, this was not possible; and it was necessary to infer the impact or to suggest a maximum possible impact.

A. NATURAL

Natural coliform concentrations are defined here as the concentration that would exist without the influence of man. Recent research [20,31] has shown that very low intensities of use up to at least 45 man days per mile of stream per year have no discernible affect on the natural coliform levels. Some research[20] has implied that coliform levels can actually decrease with the presence of man as the wild animals are driven from the watershed. The minimal usage expected to have existed in the Wasatch Canyons during the 1930's and early 1940's can be considered representative of the natural watershed.

Natural concentrations at the mouth for City Creek, Big Cottonwood Creek, and Little Cottonwood Creek are shown in Figures 21 (a), (b) and (c), respectively. In such watersheds, undisturbed by man, the monthly concentrations are quite predictable and nearly always peak in August-September and fall to a minimum in late winter.

Concentrations in City Creek peak to 20 MPN/100 ml, while in Big and Little Cottonwood the peaks are to 10 to 15 MPN/100 ml, reflecting the less erodible characteristics of the granitic rock of Big and especially Little Cottonwood Canyons.

Recent coliform concentrations are shown in Figure 21 (d). This represents the level of bacterial concentrations reached after City Creek was closed to the public and the canyon had recovered from the intensive picnic and construction activity. The only canyon activity was for operation of the water treatment facilities and patrol of the watershed. Note that although the seasonal variation is essentially the same, concentrations are double those observed under natural conditions. By implication, a seasonal coliform range from 10 to 40 MPN/100 ml is the minimum obtainable range for City Creek and other northern canyons under present conditions. Extending this doubling relationship to the Cottonwood, perhaps 5 to 30 MPN/100 ml is a minimum expected range for these two Canyons.

B. CONSTRUCTION

Construction, especially earth movement and excavation, defoliates and dislodges large masses of soil which are then susceptible to erosion and transport to the stream as sediment. This sediment carries with it non-fecal and

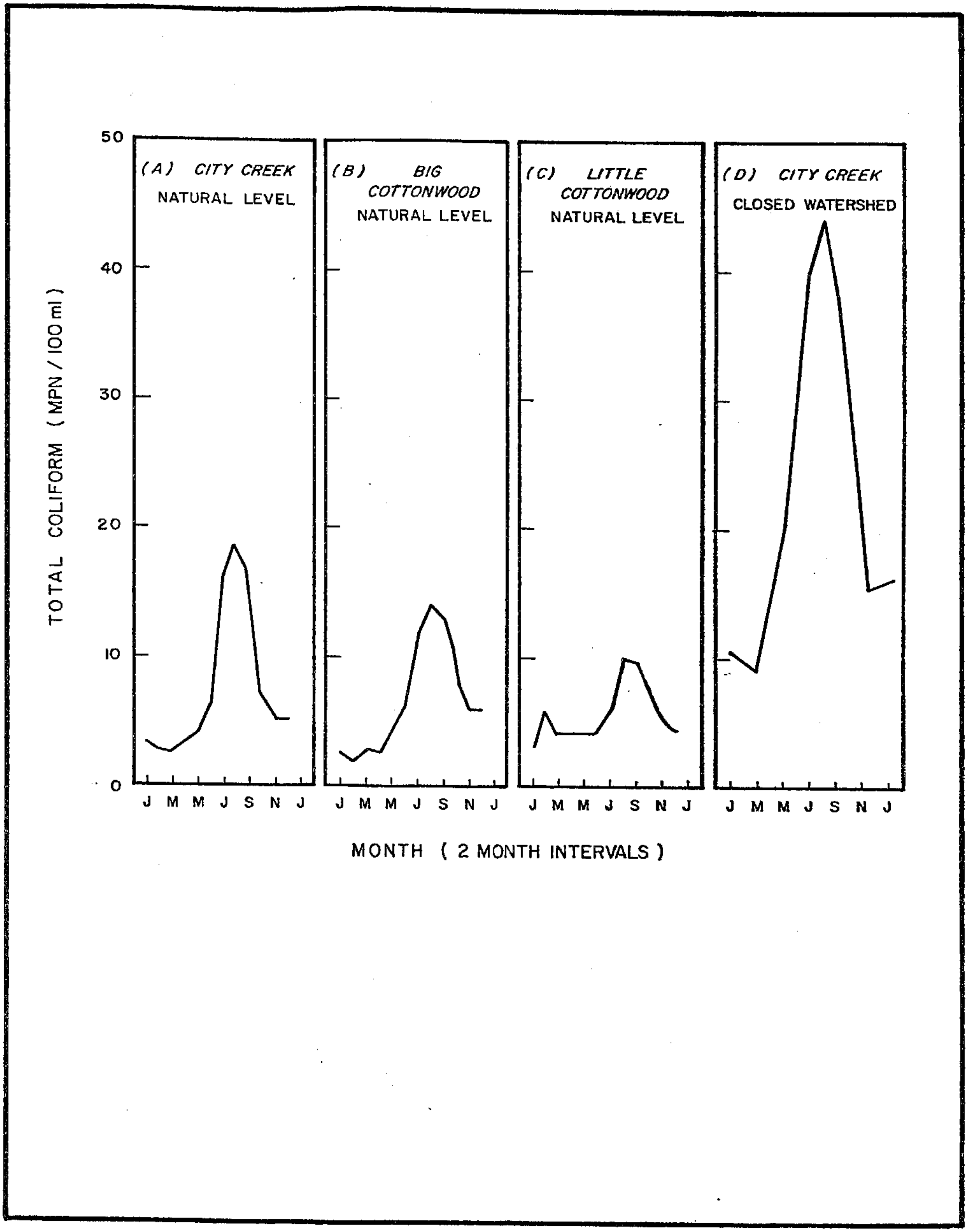


FIGURE 21

"NATURAL" COLIFORM LEVELS IN WASATCH CANYON STREAMS probably some fecal contaminates from the organic soil regions. Disturbed soil may erode for several years sending large amounts of bacteria into the stream during each rain until the site becomes revegetated or otherwise stabilized.

Concentrations of coliforms were measured in two streams during periods of construction where large amounts of earth were excavated near the stream. Figures 22 (a) and (b) show the monthly average coliform concentrations resulting from construction in City Creek Canyon and Little Cottonwood Canyon. The single year construction project of the City Creek water treatment plant in 1953 involved a large excavation just upstream from the monitoring station. The construction of the Little Cottonwood ski resort several miles upstream from the sampling point took 2-1/2 years, during which several buildings and ski lifts were constructed. The data in Figure 22 (b) represent a 3 year average.

Construction increases coliform levels an order of magnitude above natural conditions at the construction site. In City Creek, concentrations increased abruptly when construction began and varied seasonally from 100 to 250 MPN/100 ml during construction. After construction, peak concentrations dropped to 100 MPN/100 ml the first year and dropped further over the next four years. In Little Cottonwood, coliform concentrations jumped abruptly with the start of construction and remained between 40 and 80 MPN/100 as measured at the mouth of the canyon until construction ceased. There is presently insufficient data to evaluate the recovery over the next four years. However the records for 1974 and 1975 do show an abrupt decline.

The dilution of bacteria between the Snowbird site and the mouth accounts for a 2-3 fold reduction in concentrations. Accordingly, the concentrations expected to have existed below the Snowbird construction site are higher than those recorded at the mouth. According to Glenn's data[12], the flow increases by

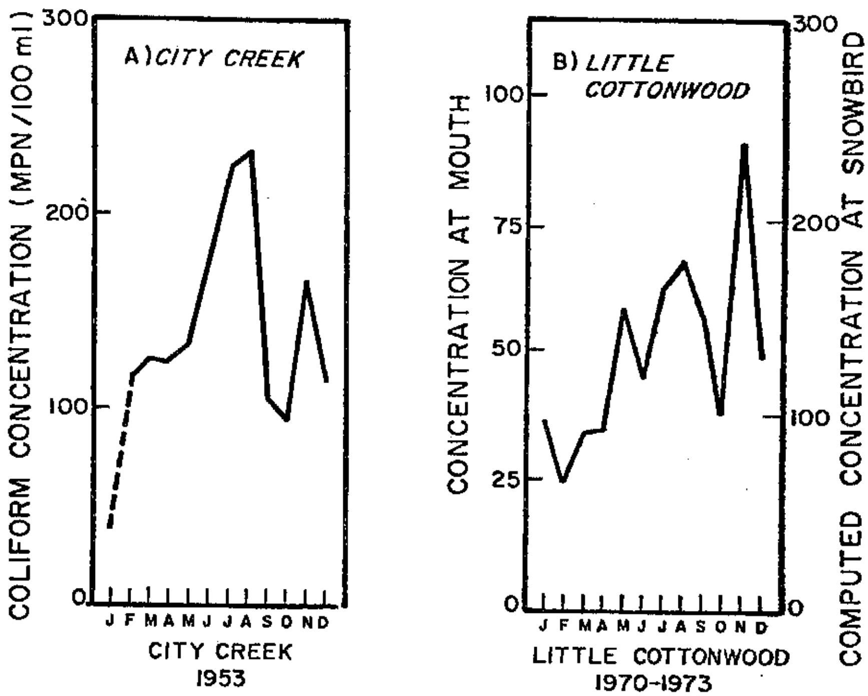


FIGURE 22

COLIFORM RESPONSE TO CONSTRUCTION

2.6 times from Snowbird to the canyon mouth. The right hand scale of Figure 22 (b) has been adjusted by 2.6 to show the estimated concentration at the Snowbird construction site. Comparison of construction in City Creek and construction in Little Cottonwood Creek shows the resulting water qualities at the site to be nearly identical. Cortell's[5] hypothesis that the bacterial load is carried by the sediments is supported by these data; i.e., if it is assumed the sediment carrying capacity of a stream is related to its discharge and that the coliform load is proportional to the sediment load, then the coliform concentration at the site will be constant as long as there exists sufficient erodible material.

C. PICNICKING, CAMPING, AND ROADSIDE VISITS

Use of picnic sites and camp grounds appears to be the largest single recreational source of high coliform levels in the Wasatch Canyons. The mechanisms through which coliforms are increased downstream of picnic and campsites is probably by 1) trampling vegetation and otherwise increasing erosion, 2) improper disposal of garbage, 3) improper use of (or improperly operating) sanitary facilities, and 4) defecation by pets and animals that frequent the sites.

The intensity of use in the Wasatch Canyons is extremely high, and consequently, the influence of the picnic/camping activities is easily measured. In other studies, which have shown no relationship between use and bacterial populations, oftentimes the density and use has been low. A study of a forested watershed in Washington State[20] showed no increase in coliform concentrations between three watersheds of various levels of human use ranging from 3 to 45 man days per mile of stream (45 man days equals approximately 100 to 150 visitor days as used in this report). The density of visitors in these watersheds is 2 orders of magnitude below that of the Wasatch Canyons.

Two periods of exclusive picnic use occur in City Creek and provide a good correlation of picnic use to pollution. Figures 23 (a) and (b) show the average monthly coliform concentrations in City Creek at the Water Filter Plant from 1949-1951 and 1969-1975 respectively. The latter period represents a 1974 use intensity of about 22,500 picnic visitors per year (22,832 and 22,419 visitors were recorded in 1974 and 1975 respectively).

Two other streams provide periods where usage can be identified as primarily, but not exclusively, devoted to picnicking and camping. Figure 23 (c) shows average coliforms in Mill Creek for 1972-1975. During this period 72,000 picnic ground users were recorded. However, there were other uses, and very likely pollution loadings from undetected malfunctioning residential septic tank systems were present. Figure 23 (d) shows the average monthly coliform concentrations in Big Cottonwood from 1969-1975. The 1974 picnic and camping intensity was 97,000 visitor days. This canyon is also used by skiers, hikers, and cabin owners. All these canyons show coliform concentrations of about the same order seasonally ranging from 50 to 100 or 200 MPN/100 ml.

Figure 23 (e) shows the average coliform concentrations of 4 selected years from 1957 to 1964 in Big Cottonwood Creek. The years selected (1957, 1960, 1961 and 1964) are those showing no obvious signs of pollution from wastewater or construction. During the 1957-1964 period, summer traffic levels remained relatively constant at about 60% of the 1969-1974 period described above and shown in Figure 23 (d). Assuming the same mix of summer visitors to the canyon, the picnic and camping intensity for this period can be estimated to be 60,000 visitor days. As shown in Figure 23, summer concentrations at the lower use intensity are approximately 60% of the higher use, indicating an apparent correlation between the two. Winter coliform concentrations have increased more than

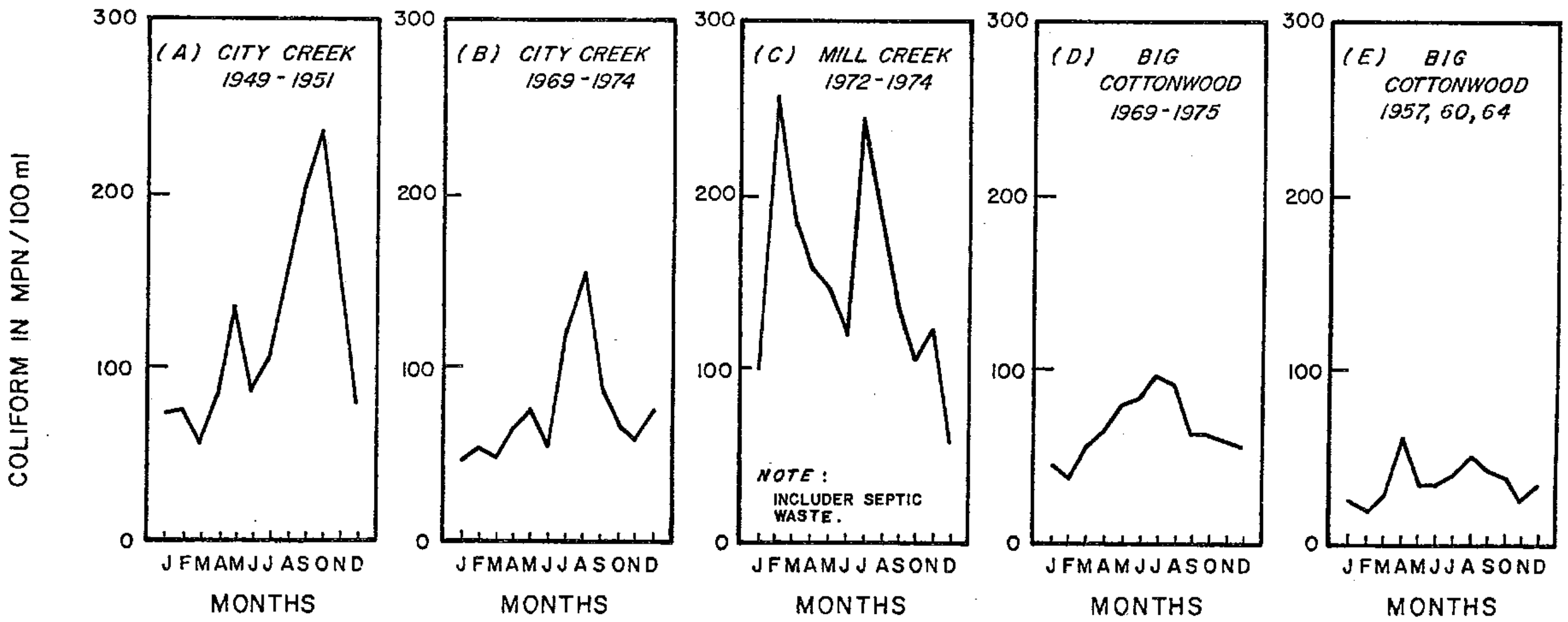


FIGURE 23

COLIFORM CONCENTRATIONS FROM PICNIC / CAMPING USAGE indicated by the summer traffic levels. The relationship between the winter traffic and winter concentrations will be discussed later.

A summary of the coliform ranges and picnic/camping intensity on each stream is presented in Table X. Unit pollution responses are shown as they relate to visitor days per mile of stream. Annual visitor days have been proportioned to the length of stream to maintain consistency between comparisons. Unit concentrations range from 9 to 17 MPN/100 ml per 1,000 annual visitor days per mile of stream for the various streams with picnic/camping activities. In general, unit pollution levels are consistent between streams. Better consistency, though, is seen within the same stream; i.e., Big Cottonwood. The summer maximum concentration appears to be more representative of summer picnickers than the winter low or the annual average concentration.

In addition to water pollutuion from authorized picnicking and camping in the canyon creeks, it is suspected from analysis of Little Cottonwood Creek (Section IV of this report) that another picnic related but unreported source of water quality deterioration exists. This is picnicking in non-designated areas. As mentioned earlier, in the discussion of Little Cottonwood, the apparent common practice of roadside picnicking can be a potential source of excessive fecal and non-fecal material. Picnicking and camping in areas without sanitary and recreational facilities can lead to additional erosion and contamination by sanitary wastes.

The coliform concentrations at the mouth of Little Cottonwood for 1974-1975 are shown in Figure 23 (e). These years represent a period when the primary source of pollution entered at several locations between Alta and the mouth of the canyon. No official picnic or campsites or cabins are located in this

TABLE X

COMPARISON OF PICNIC/CAMPING USE AND COLIFORM LEVELS

CREEK	PICNIC/CAMPING		USAGE	COLIFORM RANGE MPN/100 ml			COLIFORM per 1,000 Visitors/Mile/Year		
	1974 Visitor-Days	Approx. Stream Miles	Visitors* per mile	Avg. Low	Avg. High	Annual Avg.	Avg. Low	Avg. High	Annual Avg.
City Creek	22,500	5	4.5	50	150	75	11	33	17
Mill Creek	72,000	8	9.0	90	250	150	10	27	17
Big Cottonwood	97,400	13	7.5	50	90	70	7	12	9

*In 1,000's

stretch of the stream. However, 97,000 roadside visits were made during 1974. Table XI presents a similar analysis to that of the previous table in which coliform concentrations were related to the recreational use density. Table XI includes an estimate of unauthorized picnic activity by assuming 1/3 the reported roadside visits in each canyon resulted in picnic or camping activities. The range of annual average coliforms per 1,000 visitors per mile is 7 to 17 MPN/100 ml. Typical minimum and maximum coliforms are also shown and vary accordingly. The unit coliform responses from stream to stream are reasonably similar, especially considering the short period of record and the subjectivity of applying the land use data. The attempt to make inter-canyon comparisons brings many unknown factors into play. In both tables, unit concentrations seen in City Creek are comparatively higher than the others. Mill Creek is very likely to have additional bacterial contamination from residential users and should overstate the affect of picnickers and hence serve as an upper limit. It does just that when compared to the Cottonwoods. The unit concentrations from City Creek are perhaps double what would be expected. Additionally, City Creek shows a pronounced lag in the summer peak not shown in other creeks. City Creek concentrations peak in late summer. It is possible 1) this canyon responds differently than the others to picnic activity; 2) the type of picnic activity is more intense or closer to the streams; or lastly and most likely, 3) the level or type of use has been inaccurately estimated.

Table XI provides valuable general information. In the Wasatch Canyons annual visitor densities of approximately 5,000 to 10,000 annual visitors per mile of stream result in annual average coliform concentrations ranging from 50 to 100 above natural background conditions of about 10 MPN/100 ml.

TABLE XI

COMPARISON OF PICNIC, CAMPING AND ROAD UNIT USE
TO COLIFORM LEVELS

CREEK	PICNIC/CAMPING/ROAD VISITS* 1974 Visitor-Days	Approx. Stream Miles	Visitors ** per mile	COLIFORM RANGE MPN/100 ml Avg. Low	Avg. High	Annual Avg.	COLIFORMS per 1,000 Visitors/Mile/Year Avg. Low	Avg. High	Annual Avg.
City Creek	22,500	5	4.5	50	150	75	11	33	17
Mill Creek	120,000	8	15.0	90	250	150	6	17	10
Big Cottonwood	136,000	13	10.5	50	90	70	5	9	7
Little Cottonwood	42,800	10	4.3	25	50	35	6	12	8

*Road visits included at 1/3 reported level

**In 1,000's

D. HIKERS

The influence of hikers on the bacterial concentrations of the Wasatch streams is estimated to be extremely low. No definite correlation between pollutant loads and these activities can be found. However, hikers may be making a small contribution to the general 10 year increase in pollutant levels that has accompanied the increase in recreational activities.

The mechanisms by which hikers can increase pollutant concentrations in streams are by 1) destroying vegetation near trails and increasing the erosion potential, 2) disposing of sanitary wastes near streams, and 3) leaving trash and garbage. The number of hikers throughout the watersheds is small compared to picnickers and campers, and the density of hikers throughout the watershed is small. Furthermore, their activities are not necessarily centered about the waterways, and those activities occurring near streams and lakes may be days or months removed from the main canyon stream through lakes with high residence time.

E. SKIERS AND WINTER USAGE

Winter recreational use of the Cottonwood Canyons has climbed steeply in the 1970's and a significant portion of the winter visitors are downhill skiers. Other winter uses include sight seeing, cabin visits, and cross-country skiing. In Big Cottonwood Canyon, skiers apparently comprise about 1/4 to 1/2 of the total canyon winter visits. However, in Little Cottonwood, the winter usage is nearly exclusively devoted to skiers. Even with the very intensive winter use, coliform concentrations have risen very little. It is presently not possible to determine specifically which of the winter usages causes the pollution, but indications are that skiers may play a lesser role than previously thought[12].

If skiers are in fact making a contribution to the pollutant load, it is likely to amount to only a portion of the general increase occurring in the last 10 years as a result of increasing usage from many winter recreational activities.

The single mechanism by which skiers and other winter sports may increase coliform concentration in streams is by disposing of garbage and litter in the watershed. Leaky sewage disposal facilities and the disposal of kitchen wastes are mechanisms by which cabin users and resort owners may contribute to the bacteriological load. Because of the cold weather and snow cover, the problems associated with summer visitors are not present in the winter. For the most part winter visitors are unable to destroy the natural cover of vegetation and increase the possibility of erosion which, as has been indicated previously, appears to be a major source of coliform contamination. In addition, recent studies involving the survival of bacteria in cold climates indicate coliform bacteria cannot survive long periods in the winter environment of the Wasatch Canyons.

Work by Gordon[13] showed total coliforms counts were reduced to 3.2 to 6.5 percent (fecal: 2.1 to 4.2 percent) after 7 days travel in water at 0°C. This suggests that any fecal or other bacterial deposits caused by skiers and not released to the primary stream during the winter or early spring would die and consequently not be observed downstream. Thus, it would not be possible for winter sports to contribute to coliform concentrations measured during the summer or late summer months. Analysis of the pollution contribution made by skiers should be restricted to the winter months, e.g., November through April. Contributions from leaky waste disposal facilities of the cabins and lodges may persist throughout the year.

An analysis of the average winter coliforms in two streams with heavy skier activity, Big and Little Cottonwood, shows a gradual increase in winter coliforms commensurate with increasing winter recreational activity. Figure 14 shows the gradual increase in the winter concentration for Big Cottonwood from 1961 to 1974. These data are plotted in Figure 24 against the winter (November-April) Average Daily Traffic. The relationship between winter usage and winter bacterial concentration is convincing but inconclusive, since other factors exist (such as summer usage) which will also correlate to rising winter coliform counts. The correlation shown, however, is superior to the others. When two years (1963 and 1971) have been discarded as representing additional unaccounted pollution from other sources, the correlation is quite convincing. These years have not been included because of indicated construction in 1962-1963 and another unidentified load in 1971. The best fit line determined by linear regression has a correlation coefficient of .91. Figure 24 suggests that the winter water quality in Big Cottonwood rises at a rate of 5.5 MPN/100 ml per 100 vehicles per day increase and is insensitive to a winter use intensity less than 1,000 vehicles per day. The relationship between the average daily winter traffic (T_T) in vehicles per day and the average winter coliform concentrations (C) in MPN/100 ml can be expressed by:

$$C = \frac{5.5}{100} (T_T - 1000) + C_B \qquad \text{for } T_T > 1000 \qquad (1)$$

Where C= avg. stream coliform concentration in winter (org/100ml)

T_T = avg. daily winter traffic (vehicles/day)

C_B = background stream coliform concentration (org/100ml)

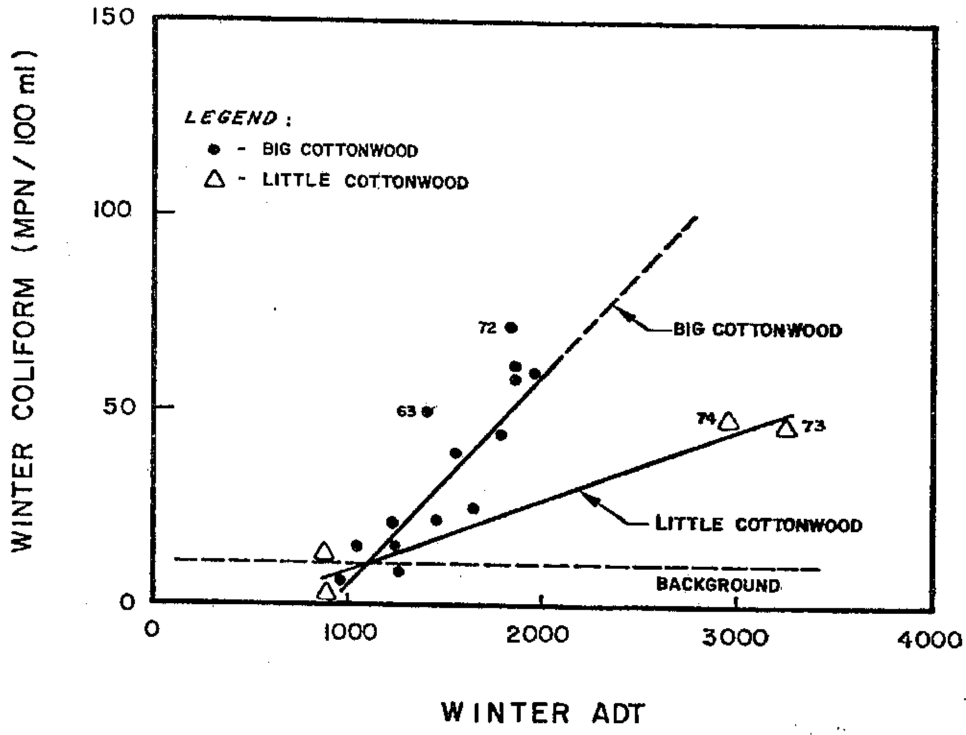


FIGURE 24

WINTER ADT AND COLIFORM CONCENTRATIONS IN BIG AND LITTLE COTTONWOOD CREEKS AT THE MOUTH

Similar data from Figure 17 of Little Cottonwood Canyon is also plotted on Figure 26. Data prior to the summer of 1970, when construction began in this canyon, are shown clustered below an average ADT of 1,000 vehicles per day at the background winter coliform concentrations. As in Big Cottonwood, no water quality effect is discernable below the winter usage represented by 1,000 vehicles per day. At 3,000 vehicles per day, the winter concentrations expected from the analysis of Big Cottonwood are shown to be 2.5 times those recorded after the construction of Snowbird. The discrepancy has arisen because coliform concentrations generated by residential and skier visits in Big Cottonwood is compared with concentrations generated by essentially only skiers in Little Cottonwood. The implication of the data for Little Cottonwood is that above 1,000 vehicles per day average winter coliform concentrations will increase at a rate of 2 MPN/100 ml per 100 vehicles per day increase in an area that is primarily catering to skiers. The expression for coliform concentrations in Little Cottonwood Creek is thus:

$$C = \frac{2}{100} (T_T - 1000) \qquad \text{for } T_T > 1000 \qquad (2)$$

A comparison of equation (2) with equation (1) suggests that winter pollution in Big Cottonwood originates from non-skier winter activities. Perhaps the largest of these is residential and cabin usage. Insufficient data on the winter activities are available to draw further conclusions.

F. RESIDENTIAL

Disposal of residential sanitary waste water presents the most serious threat to water quality of all canyon land uses. Use of cabin areas and residences of the density existing in the Wasatch Canyons, however, does not appear to have a significant impact on water quality except perhaps as an indistinguishable contribution to the total impact assigned to recreational uses.

Two methods of waste water disposal are practiced in the canyons depending on whether or not the watershed serves as a domestic water supply. The "controlled" waste management program existing in domestic water supply canyons requires the disposal of all toilet wastes outside the canyon either by vaulting or by sewering. Septic tanks may be used for non-sanitary wastes. In other canyons, "improved control" waste management programs allow for septic tank disposal of residential waste water.

Because of the apparent unsuitability[28] of all canyons for septic tanks caused by severe slopes, soil conditions, and proximity to the streams, bacterial loads in uncontrolled canyons are extreme. In these canyons, coliform concentrations are 100 times the natural concentrations occurring before the influence of man. In addition, septic tank disposal of sanitary waste in Emigration Canyon produces coliform concentrations at least 10 times higher than that produced by any other land use or activity currently (or historically) existing in the canyons.

Figures 25 (a) and 25 (b) present average monthly coliform data in Emigration and Mill Creeks. Neither canyon has had a major waste management program because the creek water is not used as a domestic water supply. Figures 25 (a) and (b) show the average coliform levels when the canyon waste management was at a minimum in the late 1960's. An "improved" (but still not totally effective) waste management program in the 1970's resulted in the improvement in bacterial water quality shown in these figures.

Finally, Figure 25 (c) depicts the concentrations in a "controlled" canyon, Big Cottonwood, from 1970-1974. Although other uses and other sources of pollution do exist in each canyon, local residential waste disposal is apparently the primary source of pollution.

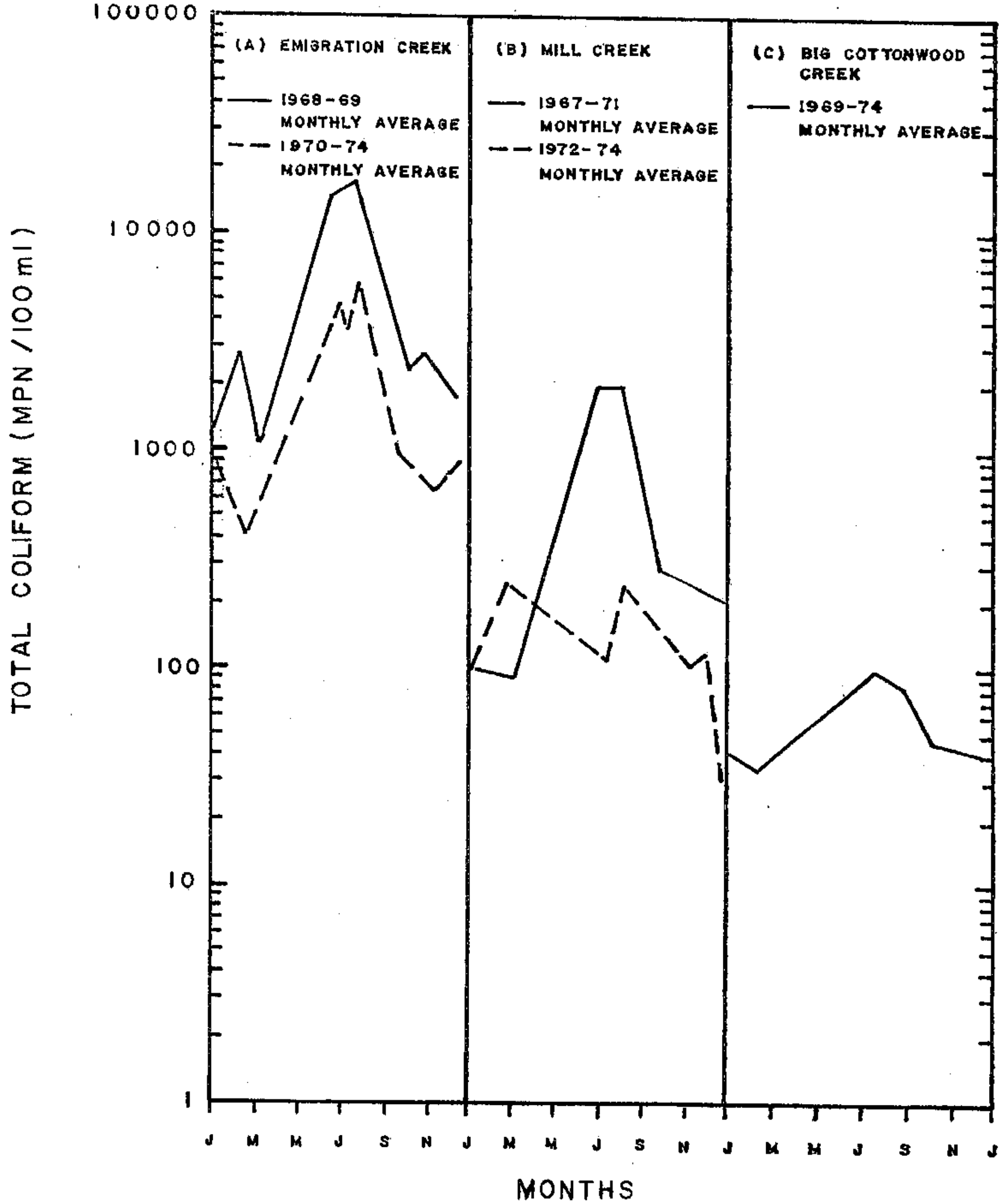


FIGURE 25
COLIFORM CONCENTRATION RELATED
TO RESIDENTIAL USE OF CANYONS

Coliform loads from other uses are inconsequential compared to that from residential use in minimum control canyons.

Figure 25 (a) and (b) show the improvement in water quality that apparently can be accomplished by an improved management program involving surveillance and correction. The reduction in Mill Creek coliform concentrations originating from residential use may even be greater than that illustrated. Mill Creek receives extensive picnic use, and as previously discussed, the effect of picnickers is of the same magnitude as the existing concentrations. Similarly, other uses in Big Cottonwood Canyon may (and probably do) comprise a substantial portion of the concentrations shown in Figure 25 (c) (see the section on picnickers). Thus, the bacterial concentration resulting from the residential waste disposal in "controlled" canyons is not large compared to other uses. It may be very low or nearly zero. Data are not available to separate the effects of this use from that of other concurrent uses.

Table XII shows a comparison of the coliform concentrations in the two creeks with "minimum" residential waste management programs. Concentrations are presented in terms of residential density to make comparison simpler. Two density factors; 1) developed acres per mile of stream, and 2) number of cabins per mile of stream are shown. Neither "cabins per mile" nor "developed acres per mile" are entirely satisfactory indicators of resulting pollution concentrations. They do, however, show fairly good inter-canyon and intra-canyon consistency.

TABLE XII

COMPARISON OF RESIDENTIAL USE AND COLIFORM LEVELS

CREEK	PERIOD	WASTE MGMT. PRGM.	AVG. ANNUAL FLOW CFS	DEV. ACRES	NUMBER OF CABINS	DEV. ACRES/ STREAM MILE	CABINS/ STREAM MILE	COLIFORM CONC. MIN.	MAX.	AVG.	COLIFORM CONC. (MPN/100 ml) ACRE-MILE MIN.	MAX.	AVG.	COLIFORM CONC. (MPN/100 ml) CABIN-MILE MIN.	MAX.	AVG
Emigration Creek	'68-69	Minimum Control	10	186	238	19	24	1000	12000	5700	50	630	300	40	500	240
Emigration Creek	'70-74	Improved Control	10	186	238	19	24	500	6000	2100	30	300	110	20	250	90
Mill Creek	'67-71	Minimum Control	18	54	72	7	9	120	2000	750	18	290	110	13	220	80
Mill Creek*	'72-74	Improved Control	18	54	72	7	9	90	250	150	13	40	20	10	30	7
Big Cottonwood*	'69-74	Control	27	--	440	-	34	50	90	70	--	--	--	1	3	2

*The Mill Creek (in latter years) and Big Cottonwood analysis are provided for comparison only. A substantial source of pollution in these creeks is from picnic and other recreational use. Hence, unit loading rates do not properly represent residential contributions.

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APPENDIX A

WATER QUALITY DATA

TEMP, pH, DO, COND., T. COLIF. F. COLIF.
EMIGRATION CREEKS, EC8 THROUGH EC1 - EPA
6/19/72 - 6/25/72

Emigration Canyon Stations

Station No.	Approx. Miles from Mouth	Description
EC-1	14.5	Upstream control station - near large tree at end of road.
EC-2	12.8	Opposite bus turn-around area.
EC-3	--	Killyon Canyon Creek about 100 yds. upstream from confluence with Emigration Cr.
EC-4	11.4	At USGS marker, opposite roadside historical marker.
EC-5	10.3	Footbridge over creek at "Shaw" residence.
EC-6	9.8	At culvert under roadway at "Story" residence.
EC-7	8.6	In field area at large tree.
EC-8	7.4	At "148 E. Sunnyvale."

RESULTS OF ANALYSIS

JUNE 1972 STUDY

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	pH SU	DO mg/l	Cond. umho	T.Coli T/100ml	F.Coli T/100ml
EC-1	72/06/19	1148	9	-	-	-	29	<2
	72/06/20	1105	8.5	-	-	-	30	4
	72/06/21	0942	8	7.6	8.9	550	18	12
	72/06/24	0828	8.5	-	-	-	18	12
	72/06/24	1130	9	7.6	8.9	545	-	-
	72/06/25	0915	8.5	-	-	-	12	8
EC-2	72/06/19	1157	9	-	-	-	35	6
	72/06/20	1115	9.5	-	-	-	42	18
	72/06/21	1005	10	7.7	8.8	550	54	35
	72/06/24	0835	9.5	-	-	-	40	28
	72/06/24	1210	10.5	7.7	8.6	560	-	-
	72/06/25	0924	9.5	-	-	-	35	10
EC-3	72/06/19	1203	10	-	-	-	84	2
	72/06/20	1119	9.5	-	-	-	20	2
	72/06/21	1015	10	7.6	8.8	455	52	15
	72/06/24	0842	10	-	-	-	55	20
	72/06/24	1225	11.5	7.8	8.5	460	-	-
	72/06/25	0928	9.5	-	-	-	58	25
EC-4	72/06/19	1211	10	-	-	-	290	130
	72/06/20	1128	9	-	-	-	2800	210
	72/06/21	1030	10	7.7	8.8	550	210	36
	72/06/24	0850	10	-	-	-	180	38
	72/06/24	1433	13	7.9	8.1	515	-	-
	72/06/25	0938	10	-	-	-	300	49
EC-5	72/06/19	1218	10	-	-	-	320	130
	72/06/20	1136	9	-	-	-	2700	2500
	72/06/21	1042	11	7.9	8.8	615	450	200
	72/06/24	0856	11	-	-	-	320	200
	72/06/24	1522	13.5	8.0	8.4	610	-	-
	72/06/25	0942	10	-	-	-	600	290
EC-6	72/06/19	1224	10	-	-	-	400	150
	72/06/20	1141	9	-	-	-	450	210
	72/06/20	1625	13	8.2	8.4	610	-	-
	72/06/21	1054	11	-	-	-	480	260
	72/06/24	0901	12	-	-	-	570	230
	72/06/24	1532	13.5	8.0	8.1	635	-	-
	72/06/25	0947	11	-	-	-	2300	1200
EC-7	72/06/19	1230	11.5	-	-	-	380	150
	72/06/20	1147	11	-	-	-	740	190
	72/06/20	1610	14	8.1	8.5	640	-	-
	72/06/21	1100	11.5	-	-	-	490	300
	72/06/24	0907	11.5	-	-	-	1000	260
	72/06/24	1544	14	7.9	8.1	660	-	-
	72/06/25	0953	11	-	-	-	2000	520
EC-8	72/06/19	1242	12	-	-	-	480	160
	72/06/20	1156	11.5	-	-	-	520	290
	72/06/20	1555	15	8.2	8.4	615	-	-
	72/06/21	1105	12.5	-	-	-	630	270
	72/06/24	0912	12	-	-	-	670	250
	72/06/24	1558	15.5	7.8	8.2	640	-	-
	72/06/25	0959	11.5	-	-	-	1400	260

FLOW, CFS   CITY CREEK AT FILTER PLANT- SLCWD   30/MO 30-75

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1930	8.0	8.1	8.7	13.9	22.5	16.2	10.9	9.1	9.0	8.0	7.3	6.8	10.7	CCM 030
1931	6.8	6.7	6.6	9.9	17.6	12.3	8.9	7.2	6.5	6.4	6.1	5.9	8.4	CCM 031
1932	5.7	6.2	8.1	20.4	53.9	38.6	17.6	11.1	8.5	7.9	7.7	7.3	16.1	CCM 032
1933	7.2	6.9	8.3	12.5	28.9	47.6	16.3	11.2	9.2	8.4	8.1	8.0	14.4	CCM 033
1934	7.5	6.9	7.3	7.7	7.4	6.1	4.9	4.5	4.7	5.0	5.4	5.8	6.1	CCM 034
1935	5.5	6.3	7.2	13.9	37.0	39.1	15.6	10.0	8.1	7.6	7.9	7.2	13.8	CCM 035
1936	7.1	7.3	13.3	35.1	70.2	39.8	18.6	11.7	9.2	8.6	8.2	7.7	19.7	CCM 036
1937	6.9	7.5	11.0	18.8	60.3	36.1	19.2	11.8	9.4	8.9	8.1	7.8	17.1	CCM 037
1938	7.3	7.1	10.2	27.4	53.7	34.9	17.1	11.8	9.4	8.9	8.9	8.4	17.1	CCM 038
1939	8.0	7.6	11.4	19.2	32.3	16.9	11.4	9.0	8.0	7.5	7.2	7.0	12.1	CCM 039
1940	7.2	7.5	11.7	22.2	37.6	19.7	12.5	9.4	8.1	8.2	8.3	7.6	13.3	CCM 040
1941	7.2	8.5	11.4	19.1	49.2	34.6	19.8	13.1	10.9	10.0	9.3	8.8	16.8	CCM 041
1942	8.8	8.9	11.4	36.5	50.9	53.0	26.0	16.5	12.8	11.8	10.6	10.7	21.5	CCM 042
1943	10.5	10.6	12.4	27.8	30.2	28.1	16.7	12.5	9.9	8.1	8.3	7.9	15.2	CCM 043
1944	7.2	7.3	8.1	15.4	46.2	41.3	20.3	13.4	10.4	10.1	7.0	8.3	16.2	CCM 044
1945	7.6	7.6	7.8	10.4	29.1	33.0	17.6	13.0	10.3	9.1	8.4	7.6	13.5	CCM 045
1946	7.3	7.0	10.2	24.7	32.2	25.0	14.3	10.1	8.3	8.1	8.0	8.0	13.6	CCM 046
1947	7.5	9.1	11.5	17.9	45.8	26.3	16.9	12.3	9.3	8.3	9.0	8.3	15.2	CCM 047
1948	7.2	5.8	8.9	21.4	53.4	36.0	16.8	11.9	10.7	9.1	9.0	8.0	16.5	CCM 048
1949	7.1	7.1	10.9	28.1	56.7	45.7	21.4	13.6	10.3	10.9	9.5	8.4	19.1	CCM 049
1950	8.1	9.7	11.3	23.6	53.1	48.8	22.9	14.3	11.3	10.6	9.9	8.8	19.4	CCM 050
1951	8.4	8.9	9.7	17.8	45.0	32.5	17.4	13.8	9.6	8.3	8.1	8.2	15.6	CC 051
1952	8.4	8.7	10.5	39.5	98.6	61.8	25.9	16.0	12.0	10.5	10.0	9.3	25.9	CCM 052
1953	9.2	8.8	9.7	17.3	34.6	57.8	21.4	14.8	10.7	9.3	9.7	8.9	17.7	CCM 053
1954	8.7	8.8	9.5	12.7	18.0	12.1	8.7	6.9	5.8	5.4	5.6	5.7	9.0	CCM 054
1955	5.5	5.3	4.5	10.6	31.0	23.0	11.7	8.2	6.5	6.1	6.0	8.3	10.6	CCM 055
1956	6.7	5.6	8.7	14.7	34.8	22.5	12.0	8.6	6.8	6.8	6.4	6.4	11.7	CCM 056
1957	5.5	6.3	7.2	12.6	39.6	43.4	19.4	12.0	9.0	8.4	7.2	6.3	14.7	CCM 057
1958	6.7	8.7	8.3	16.4	58.6	40.2	16.6	11.1	8.8	8.3	7.8	7.7	16.6	CCM 058
1959	7.6	6.7	6.9	9.2	16.1	15.0	9.9	7.9	6.9	6.6	6.1	5.7	8.7	CCM 059
1960	6.1	6.2	8.3	18.1	31.3	18.0	10.4	7.5	7.2	6.7	7.2	8.3	11.3	CCM 060
1961	5.6	5.9	6.6	8.1	11.8	9.2	6.4	5.7	5.4	5.3	5.5	5.4	6.7	CCM 061
1962	5.2	6.9	8.3	25.7	44.7	32.5	17.1	10.4	8.0	7.5	7.3	6.9	15.0	CCM 062
1963	6.1	6.2	6.7	9.5	29.3	19.8	10.5	7.7	6.7	6.0	6.1	5.7	10.0	CCM 063
1964	5.3	5.3	5.8	10.3	48.6	50.7	24.5	13.6	9.5	8.3	8.1	8.3	16.5	CCM 064
1965	7.8	9.5	9.9	18.9	54.4	53.8	24.1	15.6	12.7	11.2	10.3	9.4	19.8	CCM 065
1966	8.6	7.8	11.3	22.0	32.6	18.7	11.7	8.6	7.4	7.4	6.7	6.6	12.4	CCM 066
1967	6.0	6.1	7.6	12.0	33.8	41.7	20.5	12.8	9.4	8.6	7.9	7.3	14.5	CCM 067
1968	7.0	7.4	9.5	15.9	40.0	0.0	22.3	15.5	11.5	11.1	10.4	8.9	14.5	CCM 068
1969	8.7	6.9	8.3	13.5	21.9	21.4	16.7	11.9	9.2	7.8	7.3	6.9	11.7	CCM 069
1970	8.8	9.8	9.1	10.5	47.4	55.3	24.1	13.3	11.0	9.4	9.6	9.5	18.2	CCM 070
1971	9.9	13.1	15.3	35.4	57.4	53.3	27.4	16.3	12.7	11.7	16.7	10.9	23.3	CCM 071
1972	9.7	10.3	22.6	29.8	58.6	27.9	19.9	13.4	10.9	10.6	9.6	8.7	19.3	CCM 072
1973	8.4	8.6	10.5	17.1	58.5	46.1	21.8	14.0	11.8	10.5	9.8	9.4	18.9	CCM 073
1974	9.3	9.5	17.3	30.0	79.4	53.8	27.1	15.5	12.1	11.4	10.4	10.5	23.9	CCWP-074
1975	10.0	9.0	11.8	14.8	50.4	99.0	49.2	33.1	15.4	13.5	11.5	11.5	27.4	CCWP-075
AVERAGE	7.5	7.7	9.8	18.9	42.3	35.3	17.9	12.0	9.4	8.7	8.3	7.9	15.4	

COLIF MPN/100 CITY CREEK AT FILTER PLANT- SLCWD 40/MO 30-75 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1930	1.0	0.0	0.0	1.0	1.0	5.0	15.0	18.0	15.0	8.0	3.0	2.0	5.8	CCWP C30
1935	5.0	6.0	4.0	3.0	5.0	4.0	20.0	19.0	18.0	5.0	3.0	5.0	8.1	CCWP C35
1940	3.0	3.0	3.0	2.0	2.0	6.0	20.0	19.0	22.0	14.0	4.0	4.0	8.5	CCWP C40
1945	1.0	2.0	2.0	0.0	4.0	8.0	11.0	20.0	10.0	4.0	9.0	8.0	6.6	CCWP C45
1946	2.0	2.0	0.0	4.0	2.0	6.0	11.0	16.0	18.0	2.0	5.0	9.0	6.4	CCWP C46
1947	7.0	4.0	5.0	8.0	9.0	11.0	21.0	18.0	15.0	9.0	6.0	2.0	9.6	CC... C47
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AVERAGE	3.2	2.8	2.3	3.0	3.8	6.7	16.3	18.3	16.3	7.0	5.0	5.0	7.5	

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1948	4.0	5.0	4.0	7.0	9.0	8.0	15.0	48.0	40.0	16.0	3.0	20.0	14.9	CCWP C48
1949	14.0	16.0	11.0	44.0	120.0	78.0	141.0	144.0	146.0	160.0	103.0	75.0	87.7	CCWP C49
1950	42.0	83.0	48.0	131.0	224.0	132.0	104.0	156.0	385.0	252.0	193.0	73.0	151.9	CCWP C50
1951	161.0	124.0	107.0	72.0	26.0	44.0	72.0	160.0	74.0	300.0	142.0	86.0	114.0	CCWP C51
1952	69.0	28.0	24.0	47.0	141.0	116.0	57.0	103.0	103.0	123.0	43.0	47.0	75.1	CCWP C52
1953	33.0	115.0	125.0	124.0	130.0	187.0	224.0	232.0	103.0	94.0	168.0	112.0	137.2	CCWP C53
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AVERAGE	53.8	61.8	53.2	70.8	108.3	94.2	102.2	140.5	141.8	157.5	108.7	68.8	96.8	

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1954	252.0	0.0	0.0	0.0	0.0	0.0	0.0	90.0	102.0	58.0	20.0	20.0	90.3	CCWP C54
1955	13.0	23.0	8.0	32.0	26.0	37.0	57.0	74.0	84.0	55.0	16.0	24.0	37.4	CCWP C55
1956	15.0	8.0	16.0	8.0	16.0	24.0	47.0	73.0	78.0	19.0	3.0	4.0	25.9	CCWP C56
1957	11.0	4.0	0.0	5.0	6.0	2.0	56.0	39.0	34.0	11.0	8.0	7.0	15.3	CCWP C57
1958	3.0	4.0	4.0	10.0	1.0	3.0	7.0	9.0	15.0	20.0	25.0	32.0	11.1	CCWP C58
1959	11.0	7.0	4.0	9.0	16.0	13.0	30.0	65.0	39.0	22.0	6.0	8.0	19.2	CCWP C59
1960	8.0	12.0	14.0	13.0	29.0	25.0	49.0	12.0	10.0	14.0	4.0	4.0	16.2	CC C60
1961	2.0	1.0	1.0	3.0	8.0	26.0	47.0	77.0	25.0	12.0	3.0	4.0	17.4	CCWP C61
1962	3.0	4.0	6.0	9.0	13.0	32.0	31.0	20.0	16.0	13.0	9.0	10.0	13.8	CCWP C62
1963	16.0	10.0	6.0	6.0	15.0	17.0	22.0	21.0	30.0	19.0	2.0	0.0	14.9	CCWP C63
1964	4.0	3.0	2.0	6.0	27.0	20.0	20.0	17.0	20.0	13.0	12.0	13.0	13.1	CCWP C64
1965	10.0	7.0	10.0	21.0	39.0	44.0	43.0	51.0	40.0	55.0	70.0	29.0	34.9	CCWP C65
1966	9.0	13.0	14.0	10.0	15.0	19.0	53.0	36.0	37.0	26.0	21.0	24.0	23.1	CCWP C66
1967	30.0	19.0	18.0	18.0	35.0	20.0	43.0	61.0	36.0	24.0	14.0	17.0	27.9	CCWP C67
1968	20.0	12.0	15.0	14.0	22.0	32.0	57.0	57.0	37.0	21.0	12.0	19.0	26.5	CCWP C68
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AVERAGE	27.1	9.1	8.4	11.7	19.1	22.4	40.1	46.8	40.2	25.5	15.0	15.4	23.6	

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1969	25.0	14.0	8.0	17.0	26.0	41.0	64.0	78.0	64.0	78.0	41.0	67.0	43.6	CCWP C69
1970	34.0	31.0	33.0	35.0	78.0	65.0	76.0	147.0	86.0	76.0	71.0	76.0	67.3	CCWP C70
1971	65.0	75.0	51.0	56.0	54.0	52.0	229.0	283.0	172.0	61.0	102.0	69.0	105.7	CCWP C71
1972	95.0	88.0	84.0	81.0	144.0	53.0	57.0	141.0	95.0	85.0	53.0	34.0	84.2	CCWP C72
1973	40.0	54.0	43.0	44.0	76.0	62.0	258.0	222.0	91.0	56.0	54.0	155.0	96.2	CCWP C73
1974	25.0	52.0	72.0	147.0	62.0	50.0	41.0	40.0	14.0	29.0	30.0	40.0	50.2	CCWP C74
1975	42.0	37.0	61.0	40.0	21.0	27.0	21.0	21.0	15.0	5.0	7.0	3.0	25.0	CCWP C75
1976	2.0	2.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	CCWP C76
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AVERAGE	41.0	44.1	45.4	60.0	65.9	50.0	106.6	133.1	76.7	55.7	51.1	63.4	65.3	

FLOW, CFS EMIGRATION CR AT MOUTH - SLCWD 30/MO 30-75

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1930	4.1	4.5	4.6	7.3	5.6	3.9	2.7	2.3	2.8	3.3	3.2	2.6	3.9	ECM 030
1931	2.5	2.8	3.5	5.0	4.9	3.3	2.0	1.9	1.7	1.6	1.8	1.7	2.7	ECM 031
1932	1.7	1.8	4.6	24.3	21.1	10.0	5.4	3.7	3.0	2.8	2.8	2.4	7.0	ECM 032
1933	2.3	2.5	3.8	14.5	24.3	12.9	6.0	3.6	2.9	2.8	2.8	2.7	6.8	ECM 033
1934	2.3	2.6	3.0	2.9	2.2	2.3	2.0	1.7	1.6	1.5	1.6	1.6	2.1	ECM 034
1935	0.7	0.6	0.7	4.1	9.5	6.7	2.3	0.9	0.8	0.7	0.7	0.9	2.4	ECM 035
1936	1.2	1.0	8.6	48.9	24.9	9.1	4.7	2.6	1.5	1.8	1.8	1.5	9.0	ECM 036
1937	1.3	1.4	6.5	21.3	23.1	8.7	4.9	2.4	1.5	1.9	1.8	1.7	6.4	ECM 037
1938	1.5	1.8	6.9	22.1	17.8	9.1	4.4	2.2	1.5	1.6	1.9	1.7	6.0	ECM 038
1939	1.8	1.7	9.4	14.6	7.4	4.1	1.9	1.4	1.2	1.7	1.7	1.7	4.1	ECM 039
1940	1.6	2.2	7.0	13.4	8.2	3.7	1.4	0.6	0.7	1.0	1.1	1.1	3.5	ECM 040
1941	1.1	2.1	6.4	15.2	15.3	7.9	5.1	2.5	1.7	2.1	2.8	1.9	5.3	ECM 041
1942	1.9	2.2	6.8	33.3	21.9	15.9	7.5	3.9	2.7	2.4	2.4	2.4	8.6	ECM 042
1943	1.9	1.9	7.0	14.7	8.7	6.8	2.9	1.6	1.2	1.5	1.8	1.6	4.3	ECM 043
1944	1.6	1.7	2.1	11.9	17.0	15.5	7.1	3.6	2.0	1.8	2.1	2.0	5.7	ECM 044
1945	1.4	1.6	2.3	5.7	11.0	9.6	3.2	1.5	1.5	1.4	1.3	1.3	3.5	ECM 045
1946	1.3	1.3	1.3	8.4	9.9	6.2	3.6	1.8	1.4	2.6	1.7	2.0	3.5	ECM 046
1947	1.0	1.7	7.7	15.7	14.8	9.4	4.3	2.5	1.9	2.4	2.2	1.7	5.4	ECM 047
1948	1.7	2.0	3.3	25.7	23.0	9.8	4.4	1.3	0.6	2.0	2.2	1.5	6.5	ECM 048
1949	1.3	3.9	6.6	32.8	21.3	12.8	5.3	2.8	1.0	1.4	1.6	1.0	7.4	ECM 049
1950	0.7	3.1	7.9	27.0	32.4	16.3	7.3	3.1	1.8	1.8	2.5	2.9	8.9	ECM 050
1951	2.0	5.3	7.1	18.5	22.1	9.9	4.7	2.8	1.2	2.0	1.9	1.3	6.6	EC 051
1952	1.6	2.3	3.7	71.3	59.4	22.6	10.4	6.8	3.1	2.1	2.3	1.8	15.6	ECM 052
1953	2.9	2.7	6.9	21.4	22.8	18.6	8.4	4.9	3.1	3.0	2.9	2.3	8.3	ECM 053
1954	2.2	2.5	3.0	6.5	3.4	2.0	0.6	0.3	0.3	0.3	0.3	0.4	1.8	ECM 054
1955	0.4	0.5	1.2	7.0	9.5	5.1	2.1	0.9	0.5	0.4	0.4	0.4	2.4	ECM 055
1956	1.6	0.5	6.5	9.6	8.5	6.6	2.1	0.5	0.6	0.4	0.4	0.4	3.1	ECM 056
1957	0.4	0.9	3.2	10.8	27.1	15.2	5.9	2.9	2.1	2.1	1.9	2.1	6.2	ECM 057
1958	3.2	4.1	5.5	28.0	38.6	12.8	5.5	2.5	1.8	1.7	2.1	2.0	9.0	ECM 058
1959	2.4	2.6	3.5	6.1	6.3	2.9	1.0	0.5	0.5	0.4	0.5	0.7	2.3	ECM 059
1960	2.8	0.8	4.5	15.1	7.2	3.7	0.4	0.4	0.4	0.4	0.4	0.4	2.9	ECM 060
1961	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.5	0.3	ECM 061
1962	0.3	0.5	2.1	20.2	11.0	5.4	2.4	0.5	0.3	0.4	0.6	0.6	3.7	ECM 062
1963	0.6	0.6	0.6	6.4	13.1	6.5	1.2	0.4	0.3	0.4	0.6	0.6	2.6	ECM 063
1964	0.5	0.5	0.6	9.5	43.4	16.0	8.1	3.4	1.4	1.4	2.1	2.1	7.4	ECM 064
1965	3.7	7.6	11.1	34.4	33.7	15.9	6.9	5.1	4.5	3.9	4.4	3.0	11.2	ECM 065
1966	2.4	2.4	6.6	11.5	8.9	5.9	4.2	1.7	1.7	4.4	5.2	3.6	4.9	ECM 066
1967	3.5	3.5	6.2	8.9	13.0	7.6	4.3	2.0	1.1	1.4	1.3	1.1	4.5	ECTS 067
1968	1.0	2.2	5.3	15.9	21.8	11.1	5.9	3.9	2.6	2.2	2.1	2.1	6.3	ECTS 068
1969	4.3	6.7	18.5	35.3	42.4	19.0	8.6	4.6	3.8	3.8	3.9	3.6	12.9	ECTS 069
1970	1.7	3.0	4.1	7.7	26.5	12.0	4.3	2.1	1.9	2.3	2.7	2.1	5.9	ECTS 070
1971	4.5	8.1	15.1	38.8	28.3	15.0	6.0	3.3	2.6	2.7	2.9	3.1	10.9	ECTS 071
1972	2.7	4.8	29.9	32.2	25.2	8.2	4.5	2.2	2.2	2.4	2.5	1.8	9.9	ECTS 072
1973	1.8	2.0	4.0	20.0	33.3	12.5	5.2	2.7	2.9	2.3	2.4	2.2	7.6	ECTS 073
1974	2.4	2.5	18.7	49.5	49.7	19.2	8.2	3.7	1.9	2.1	2.3	1.9	13.5	ECM 074
1975	2.1	2.1	5.5	16.3	83.8	46.2	15.9	4.0	7.2	3.6	2.9	2.8	16.0	ECM 075
AVERAGE	1.8	2.4	6.2	18.9	20.9	10.5	4.7	2.4	1.8	1.9	2.0	1.8	6.3	

COLIF MPN/100 EMIGRATION CR NR TUNNEL SP -SLCWD 4/MO 68-4/76 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1968	392.0	1175.0	1880.0	1434.0	6500.0	6000.0	10050.0	13625.0	14225.0	2616.0	4173.0	2767.0	5402.9	ECTS C68
1969	2075.0	5402.0	1680.0	436.0	665.0	9067.0	13650.0	10775.0	4406.0	1823.0	1750.0	1147.0	4406.2	ECTS C69
1970	853.0	467.0	1013.0	1293.0	2093.0	3649.0	7575.0	4953.0	4538.0	2163.0	2447.0	1880.0	2742.9	ECTS C70
1971	4020.0	273.0	1078.0	1395.0	1155.0	1412.0	2900.0	2120.0	3063.0	2810.0	1283.0	1750.0	1936.6	ECTS C71
1972	523.0	255.0	458.0	370.0	458.0	925.0	2267.0	2318.0	12560.0	1378.0	300.0	157.0	1830.7	ECTS C72
1973	370.0	1530.0	660.0	950.0	1180.0	3180.0	6320.0	6980.0	11480.0	1240.0	900.0	1120.0	2992.5	EC C73
1974	814.8	350.0	540.0	259.8	1414.8	264.0	3987.5	1800.0	105.0	49.0	155.0	207.3	828.9	ECM C74
1975	792.0	1266.7	3033.3	1525.0	2050.0	594.0	1500.0	750.0	233.3	78.4	69.3	147.3	995.8	ECM C75
1976	122.0	366.7	1016.0	1060.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	641.2	ECM C76
1975	725.0	950.0	2250.0	1250.0	2700.0	560.0	1500.0	720.0	230.0	78.0	68.0	148.0	929.9	ECM C75
AVERAGE	1055.5	1203.3	1360.8	997.3	2024.0	2849.1	5527.7	4893.4	5648.9	1359.5	1238.4	1036.0	2387.2	

ADT, VECL/DY EMIGRATION CR AT MOUTH- HWY DEPT ?/YR 73

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1973	6940.0	8166.0	7861.0	7564.0	10802.0	15849.0	18129.0	18725.0	14349.0	13019.0	9045.0	8421.0	11572.5	PCHADT73
AVERAGE	6940.0	8166.0	7861.0	7564.0	10802.0	15849.0	18129.0	18725.0	14349.0	13019.0	9045.0	8421.0	11572.5	

COLIF MPN/100 EMIGRATION (UPR) AT BURR FK-SLCWD 4/MO 69-4/76 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1969	3375.0	6433.0	6713.0	420.0	240.0	2160.0	2688.0	11300.0	13346.0	6675.0	2950.0	1640.0	4828.3	ECBF C69
1970	1780.0	730.0	576.0	1175.0	778.0	1476.0	1073.0	2785.0	1831.0	1258.0	3923.0	3423.0	1734.0	ECBF C70
1971	1297.0	425.0	732.0	421.0	237.0	634.0	2513.0	3840.0	2225.0	988.0	593.0	2403.0	1356.2	ECBF C71
1972	1610.0	748.0	150.0	315.0	436.0	835.0	953.0	3840.0	9600.0	3360.0	1497.0	1070.0	2034.5	ECBF C72
1973	2260.0	7930.0	3980.0	465.0	660.0	1920.0	1690.0	6350.0	6840.0	1070.0	890.0	1370.0	2952.1	ECBF C73
1974	895.0	625.0	305.0	325.0	350.0	250.0	2050.0	1230.0	238.0	68.0	360.0	495.0	599.2	ECUP C74
1975	661.0	1333.3	1920.0	425.0	342.5	680.0	1666.7	875.0	1166.7	422.0	191.0	90.0	812.8	ECUP C75
1976	176.5	88.3	692.0	860.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	454.2	ECUP C76
AVERAGE	1506.8	2289.1	1881.0	550.7	430.5	1136.4	1804.8	4317.1	5035.2	1977.3	1486.3	1498.3	1973.0	

COLIF,MPN/100 EMIGRATION (UPR) AT BURR FK-CCHD 4 AV 69-6/74 WILHELM-195 ECBF C

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1970	1340.0	550.0	670.0	990.0	730.0	1600.0	1050.0	2810.0	1630.0	1260.0	1950.0	3450.0	1502.5	ECUP-C70
1971	790.0	430.0	810.0	420.0	210.0	635.0	2120.0	4250.0	2265.0	985.0	360.0	665.0	1161.7	ECUP-C71
1972	1205.0	450.0	200.0	315.0	435.0	830.0	1260.0	5650.0	2450.0	4200.0	1495.0	1070.0	1630.0	ECUP-C72
1973	2260.0	7900.0	4100.0	678.0	425.0	1915.0	2340.0	6300.0	6800.0	1175.0	1240.0	1375.0	3042.3	ECUP-C73
1974	893.0	624.0	308.0	324.0	351.0	295.0	0.0	0.0	0.0	0.0	0.0	0.0	465.8	EC C74
AVERAGE	1297.6	1990.8	1217.6	545.4	430.2	1055.0	1692.5	4752.5	3286.2	1905.0	1261.2	1640.0	1682.1	

COLIF MPN/100 LAMBS CANYON (UPPER) =SLCWD 4/ 6/74-4/76 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.5	46.5	ULAC C73
1974	37.0	26.8	212.7	125.8	41.0	41.8	52.8	48.0	39.0	43.0	16.0	48.3	61.0	ULAC C74
1975	21.3	11.0	40.7	48.0	52.0	29.2	58.0	33.0	16.0	8.3	6.0	29.3	29.4	UL[illegible] C75
1976	2.8	4.0	17.2	67.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.9	UL[illegible] C76
AVERAGE	20.4	13.9	90.2	80.4	46.5	35.5	55.4	40.5	27.5	25.6	11.0	41.4	42.2	

COLIF MPN/100 LAMBS CANYON (LOWER) =SLCWD 4/ 6/74-4/76 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	217.3	217.3	LLAC C73
1974	109.8	29.5	127.7	136.8	56.0	65.5	31.7	33.0	43.0	48.5	14.8	66.3	63.6	LLAC C74
1975	14.0	12.0	64.0	46.0	62.0	26.4	61.0	31.0	24.0	5.3	4.0	24.0	31.1	LLAC C75
1976	5.3	2.0	18.3	69.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.8	LLAC C76
AVERAGE	43.0	14.5	70.0	84.1	59.0	46.0	46.4	32.0	33.5	26.9	9.4	102.5	50.0	

COLIF MPN/100 LITTLE DELL =SLCWD 4/ 6/74-4/76 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDF
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.3	55.3	LD C73
1974	104.4	88.3	136.3	219.8	64.0	45.8	54.5	39.3	60.0	28.0	21.3	45.7	75.6	LD C74
1975	108.0	8.0	51.3	55.5	196.7	43.2	38.7	32.0	12.0	7.8	1.0	17.0	47.6	LD C75
1976	3.5	5.7	29.2	86.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.2	LD C76
AVERAGE	72.0	34.0	72.3	120.6	130.4	44.5	46.6	35.7	36.0	17.9	11.1	39.3	57.2	

FLOW, CFS   PARLEYS CANYON AT MOUTH - SLCWD 30/MO 30-66

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1930	8.5	10.1	12.6	28.3	22.6	14.0	12.2	10.5	10.1	9.2	7.7	6.6	12.7	PCM 030
1931	6.9	7.2	8.9	16.4	22.5	11.2	8.4	5.8	5.0	5.6	5.3	6.1	9.1	PCM 031
1932	5.5	6.4	12.1	60.7	99.7	43.7	18.0	12.7	10.6	10.4	9.0	7.0	24.7	PCM 032
1933	4.9	6.5	11.3	31.4	79.2	56.3	17.4	10.0	9.4	7.9	7.5	7.6	20.8	PCM 033
1934	6.5	7.9	8.7	7.7	5.3	4.1	4.1	3.2	3.0	4.2	4.3	6.4	5.5	PCM 034
1935	5.0	6.1	8.0	23.4	51.0	36.3	15.6	9.3	6.7	6.7	7.1	6.8	15.2	PCM 035
1936	7.4	7.9	20.0	112.4	115.7	44.2	18.8	12.3	10.1	8.9	9.4	8.1	31.3	PCM 036
1937	8.3	10.2	16.0	58.9	110.5	40.6	20.4	12.0	11.3	11.2	10.4	10.6	26.7	PCM 037
1938	8.2	9.3	19.9	79.8	79.2	41.1	20.0	11.0	11.8	9.5	9.6	8.7	25.7	PCM 038
1939	8.0	8.3	18.9	45.9	32.5	16.7	9.4	7.6	8.9	8.5	6.4	7.2	14.9	PCM 039
1940	9.4	10.2	17.3	39.2	35.7	15.5	8.6	5.8	7.0	7.0	8.5	7.9	14.3	PCM 040
1941	8.0	10.3	17.0	44.6	78.9	36.1	19.6	13.3	11.3	11.8	11.0	14.1	23.0	PCM 041
1942	11.6	14.3	17.5	98.2	83.9	59.5	25.9	15.9	12.8	12.6	12.6	11.9	31.4	PCM 042
1943	11.7	12.8	25.2	65.0	45.7	36.2	19.1	12.8	11.4	12.1	10.3	11.0	22.8	PCM 043
1944	10.3	10.5	11.3	36.0	91.7	69.2	26.3	15.1	11.9	12.1	11.0	10.4	26.3	PCM 044
1945	10.4	12.3	11.6	20.8	32.3	25.0	16.0	11.7	11.9	9.8	12.4	11.0	15.4	PCM 045
1946	10.9	9.6	19.9	89.3	65.0	31.2	16.3	11.5	9.0	9.8	11.3	10.4	24.5	PCM 046
1947	10.4	12.3	20.9	54.1	80.2	42.5	21.1	14.3	14.9	13.4	12.4	12.9	25.8	PCM 047
1948	12.5	11.8	13.3	85.7	117.1	53.2	23.5	18.7	10.9	12.0	14.9	11.8	32.1	PCM 048
1949	10.5	9.0	18.2	80.8	98.0	50.6	23.7	15.3	11.6	12.6	12.5	12.5	29.6	PCM 049
1950	12.8	14.5	23.2	86.8	138.2	78.9	33.2	18.8	15.3	14.8	15.6	14.5	38.9	PCM 050
1951	12.0	17.3	21.6	65.3	99.7	49.3	24.3	17.8	13.3	13.0	13.2	13.1	30.0	PC 051
1952	13.3	13.6	16.2	167.1	222.5	94.1	35.3	20.9	15.1	12.9	12.6	12.6	53.0	PCM 052
1953	14.2	10.9	17.9	52.0	82.4	78.1	25.5	16.4	12.5	12.7	12.3	10.2	28.8	PCM 053
1954	9.4	10.0	11.7	23.8	18.4	11.8	7.3	5.9	6.0	7.0	8.5	7.5	10.6	PCM 054
1955	7.6	8.0	9.5	23.9	48.5	23.3	12.2	8.0	7.2	7.6	8.8	10.6	14.6	PCM 055
1956	11.5	5.0	25.0	37.1	47.8	24.2	13.3	7.9	8.5	8.8	7.0	7.9	17.0	PCM 056
1957	7.1	6.5	15.2	35.8	100.8	79.0	22.3	12.9	10.3	9.0	7.9	9.1	26.3	PCM 057
1958	8.2	10.4	14.3	52.5	111.8	31.9	18.5	8.7	9.9	6.9	8.4	8.1	24.1	PCM 058
1959	5.3	9.7	10.3	17.3	23.6	14.1	8.3	6.0	6.5	6.0	5.3	5.3	9.8	PCM 059
1960	7.0	6.3	16.2	39.4	30.3	16.9	9.2	7.9	5.2	5.5	5.8	5.8	13.0	PCM 060
1961	4.3	6.9	6.8	10.2	9.9	5.3	3.0	3.6	3.5	4.8	5.5	5.9	5.8	PCM 061
1962	6.0	8.8	10.9	65.7	58.9	32.6	19.3	11.8	9.2	8.3	7.1	8.5	20.6	PCM 062
1963	5.6	7.3	6.2	16.9	57.1	19.8	10.0	6.1	6.1	6.5	6.3	5.1	12.8	PCM 063
1964	4.7	5.6	5.7	24.9	126.0	55.8	30.9	17.3	10.9	9.5	7.9	15.6	26.2	PCM 064
1965	14.6	20.5	21.5	80.1	131.9	45.0	28.3	19.2	14.2	14.3	11.9	10.8	34.4	PCM 065
1966	10.5	10.2	20.9	45.3	51.7	25.8	16.1	9.9	11.3	10.8	9.8	8.9	19.3	PCM 066
1970	142.0	102.0	11.0	1.0	12.0	11.0	9.0	5.0	1.0	1.0	2.0	1.0	24.8	PCWP C70
1971	2.0	1.0	10.0	10.0	1.0	1.0	3.0	1.0	1.0	1.0	1.0	7.0	3.2	PCWP C71
1972	12.0	9.0	14.0	96.0	195.0	63.0	2.0	1.0	3.0	4.0	3.0	3.0	33.7	PCWP C72
1973	5.0	53.0	166.0	43.0	45.0	64.0	30.0	11.0	8.0	5.0	2.0	2.0	36.2	PCWP C73
1974	5.0	28.0	167.0	142.0	46.0	20.0	8.0	1.0	1.0	1.0	5.0	7.0	35.9	PCWP C74
1975	9.0	13.0	31.0	46.0	102.0	47.0	1.0	1.0	1.0	1.0	1.0	1.0	21.2	PCWP C75
1976	1.0	3.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	PCWP C76
AVERAGE	11.5	13.0	22.2	52.6	72.3	37.7	16.6	10.4	8.8	8.5	8.4	8.6	22.5	

ADT, VECL/DY PARLEYS CANYON AT MOUTH- HWY DEPT ?/MO 73

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1973	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	ECMADT73
AVERAGE	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	3700.0	

FLOW, CFS MILL CREEK AT BOUNDARY SPR- SLCWD 30/MO 30-75

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1930	6.6	7.1	10.0	14.2	19.0	15.8	10.6	10.2	10.1	11.1	9.6	9.0	11.1	MCM 030
1931	9.6	9.7	9.8	12.1	15.4	9.9	9.0	7.1	6.7	6.7	5.5	4.9	8.9	MCM 031
1932	4.8	5.0	7.3	15.2	36.4	27.3	16.8	12.3	10.5	9.1	8.5	7.2	13.4	MCM 032
1933	7.3	7.1	7.4	10.4	20.3	36.7	16.9	12.6	10.1	8.9	8.2	8.4	12.9	MCM 033
1934	7.6	7.5	7.2	7.9	7.7	6.5	5.6	4.8	4.4	5.1	5.6	5.3	6.3	MCM 034
1935	5.2	5.0	4.7	7.6	19.2	25.7	11.6	8.4	6.5	4.6	4.1	3.7	8.9	MCM 035
1936	4.1	4.3	5.6	19.3	42.3	25.4	16.4	11.6	9.3	8.0	7.3	5.3	13.2	MCM 036
1937	3.7	4.9	3.7	11.7	36.5	23.6	15.9	9.9	8.0	8.8	7.4	6.7	11.7	MCM 037
1938	5.4	5.1	8.2	19.7	42.2	31.8	17.3	12.0	9.8	7.4	6.6	5.0	14.2	MCM 038
1939	5.0	4.6	6.3	13.0	23.2	15.5	9.0	7.6	5.9	6.0	5.0	5.4	8.9	MCM 039
1940	4.9	4.6	6.7	14.5	24.5	12.7	10.0	7.9	7.6	7.2	5.6	5.0	9.3	MCM 040
1941	4.9	5.4	6.3	11.5	36.1	27.5	16.6	13.8	11.3	9.6	9.3	8.8	13.4	MCM 041
1942	8.3	8.2	7.0	22.2	41.1	44.0	21.1	16.2	11.9	9.5	8.7	8.2	17.2	MCM 042
1943	6.9	8.6	9.0	15.8	23.7	24.9	17.7	13.2	9.4	8.1	8.0	7.4	12.7	MCM 043
1944	5.5	6.9	7.2	10.6	30.6	42.6	22.4	22.4	11.8	10.4	11.2	9.1	15.9	MCM 044
1945	7.4	5.4	5.6	8.8	18.7	23.0	17.1	13.0	9.0	8.1	6.9	5.7	10.7	MCM 045
1946	8.3	8.5	8.7	22.2	36.9	24.1	16.4	12.4	9.5	9.0	7.1	7.5	14.2	MCM 046
1947	7.0	8.0	9.0	16.0	39.7	27.2	17.4	13.6	10.8	8.7	9.5	8.7	14.6	MCM 047
1948	7.7	6.0	6.1	18.0	52.6	37.6	17.8	13.7	9.3	5.9	6.3	7.2	15.7	MCM 048
1949	6.6	6.4	6.6	18.6	56.6	33.3	19.2	14.5	12.6	12.3	11.1	10.0	17.3	MCM 049
1950	8.1	10.4	11.9	22.3	46.3	48.1	22.2	15.7	14.3	12.3	12.2	11.4	19.6	MCM 050
1951	9.9	10.3	11.1	15.7	36.4	30.2	16.6	13.4	11.1	10.4	9.5	8.3	15.2	MC 051
1952	8.5	9.6	9.6	34.1	76.2	64.1	26.6	19.3	14.9	12.6	10.8	10.8	24.8	MCm 052
1953	11.3	10.2	10.3	14.4	24.4	47.9	21.1	15.5	12.1	10.4	10.0	9.0	16.4	MCM 053
1954	10.0	9.0	8.7	10.5	17.0	11.5	9.0	7.2	6.7	6.7	7.0	5.1	9.0	MCM 054
1955	6.0	5.6	7.4	10.0	24.0	19.7	13.0	9.9	8.5	7.7	7.5	8.4	10.6	MCM 055
1956	7.5	5.9	9.6	14.3	28.8	20.4	12.3	10.4	8.8	8.1	5.3	7.9	11.6	MCM 056
1957	6.8	8.0	8.8	12.3	32.2	48.1	21.0	13.9	11.3	10.0	9.5	9.0	15.9	MCM 057
1958	8.2	8.6	9.0	16.0	44.1	32.4	16.7	12.3	10.5	9.3	9.0	9.1	15.4	MCM 058
1959	8.3	8.7	8.8	10.8	15.3	17.3	10.0	8.7	8.4	7.6	6.6	7.2	9.8	MCM 059
1960	6.2	7.3	8.4	11.6	19.3	13.8	9.4	7.9	6.9	5.2	4.7	5.4	8.8	MCM 060
1961	5.9	6.1	6.3	6.6	9.2	8.5	6.2	5.5	5.5	4.3	4.6	4.3	6.1	MCM 061
1962	4.6	5.2	5.8	12.5	22.8	21.6	12.8	9.7	8.1	6.2	5.8	6.2	10.1	MCM 062
1963	5.5	6.4	6.2	6.0	16.7	15.6	9.5	7.5	6.6	5.1	4.7	4.8	7.9	MCM 063
1964	5.4	5.9	5.9	9.0	32.4	41.3	20.8	13.2	10.1	8.5	7.6	8.6	14.1	MCM 064
1965	9.3	9.2	10.5	17.6	39.9	57.2	23.2	16.1	13.6	11.0	10.8	9.0	19.0	MCM 065
1966	8.4	9.7	10.8	15.2	30.5	17.8	12.4	9.5	9.3	8.8	8.5	7.0	12.3	MCM 066
1967	6.6	7.8	8.5	9.5	30.0	45.4	21.1	14.0	11.2	10.8	10.5	11.3	15.6	MCBS 067
1968	9.7	10.7	10.6	14.4	29.4	43.2	21.4	16.2	12.6	11.0	10.6	9.7	16.6	MCBS 068
1969	10.8	11.7	13.4	18.4	43.3	48.6	23.7	16.8	14.5	13.0	12.8	11.7	19.9	MCBS 069
1970	11.2	11.1	10.7	12.8	37.9	47.4	21.9	15.8	13.8	12.2	12.2	10.2	18.1	MCBS 070
1971	11.1	11.7	13.9	26.5	43.8	47.8	22.6	16.9	14.8	13.3	13.1	12.3	20.7	MCBS 071
1972	10.0	10.4	17.8	22.5	48.7	39.2	15.9	13.6	13.0	11.6	11.5	9.2	18.6	MCBS 072
1973	9.0	10.5	10.0	12.7	41.3	36.2	17.5	13.6	12.1	10.7	10.3	9.7	16.1	MCBS 073
1974	6.7	7.6	10.9	19.9	35.0	37.3	16.5	11.4	9.5	8.8	8.9	7.6	15.0	MCM 074
1975	7.3	7.5	7.6	8.7	35.5	74.6	32.5	15.8	12.5	0.0	0.0	0.0	22.4	MCM 075
AVERAGE	7.4	7.7	8.6	14.6	32.2	31.5	16.5	12.3	10.1	8.9	8.3	7.8	13.9	

7

COLIF MPN/100 MILL CREEK AT BOUNDARY SP -SLCWD 4/MO 67-4/76 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1967	91.0	128.0	87.0	44.0	175.0	1542.0	1701.0	2042.0	712.0	225.0	47.0	36.0	569.2	MCBS1967
1968	26.0	43.0	26.0	51.0	200.0	979.0	566.0	901.0	481.0	168.0	56.0	142.0	303.2	MCBS1968
1969	29.0	68.0	73.0	1200.0	1669.0	1784.0	2490.0	2140.0	1031.0	479.0	503.0	503.0	997.4	MCBS1969
1970	309.0	300.0	382.0	861.0	1563.0	1787.0	2905.0	2193.0	1153.0	672.0	991.0	551.0	1138.9	MCBS1970
1971	203.0	161.0	92.0	407.0	633.0	643.0	2013.0	2493.0	1268.0	703.0	261.0	120.0	749.7	MCBS1971
1972	151.0	529.0	404.0	327.0	174.0	143.0	267.0	225.0	220.0	149.0	26.0	26.0	220.1	MC 1972
1973	31.0	34.0	42.0	27.0	122.0	120.0	426.0	267.0	172.0	142.0	240.0	91.0	142.8	MCBS1973
1974	95.3	211.7	129.3	126.8	137.3	96.8	66.5	50.3	18.3	33.5	100.3	57.0	93.6	MCH C74
1975	13.8	76.3	52.7	19.3	24.3	27.0	43.8	58.0	36.3	31.4	17.7	20.0	35.0	MCH C75
1976	85.7	3.7	26.4	33.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.3	MCH C76
AVERAGE	103.5	155.5	131.4	309.7	522.0	791.3	1164.3	1152.1	565.7	289.2	249.1	171.8	456.7	

TDS, MGL/100 MILL CREEK AT BOUNDARY SP - SLCWD 2/MO 71-74 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1971	444.0	374.0	396.0	366.0	348.0	372.0	321.0	334.0	360.0	375.0	415.0	359.0	372.0	MCBSTD71
1972	440.0	440.0	365.0	370.0	295.0	208.0	340.0	360.0	380.0	387.0	391.0	434.0	367.5	MCBSTD72
1973	437.0	428.0	371.0	310.0	360.0	274.0	290.0	315.0	380.0	355.0	350.0	385.0	354.6	MCBSTD73
1974	520.0	400.0	387.0	389.0	85.0	330.0	216.0	375.0	385.0	0.0	0.0	0.0	340.8	MCBSTD74
AVERAGE	455.2	410.5	379.7	358.7	272.0	296.0	291.7	346.0	376.2	372.3	385.3	392.7	359.9	

CL, MGL/100 MILL CREEK AT BOUNDARY SP - SLCWD 2/MO 71-74 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1971	17.7	15.3	16.3	23.0	8.0	13.4	7.7	21.2	8.6	6.7	8.6	14.4	13.4	MCBSCL71
1972	46.9	22.0	15.8	9.9	11.8	11.8	10.8	12.6	9.7	9.6	11.5	17.4	15.8	MCBSCL72
1973	25.1	18.4	12.8	12.4	13.8	3.9	5.4	9.8	6.2	2.0	3.0	5.0	9.8	MCBSCL73
1974	54.4	8.0	6.8	7.7	4.9	6.9	8.9	5.9	5.9	0.0	0.0	0.0	12.2	MCBSCL74
AVERAGE	36.0	15.9	12.9	13.3	9.6	9.0	8.2	12.4	7.6	6.1	7.7	12.3	12.8	

SI02, MGL/100 MILL CREEK AT BOUNDARY SP - SLCWD 2/MO 71-73 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1971	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	MCBSSI71
1972	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	MCBSSI72
1973	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	MCBSSI73
AVERAGE	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	

ADT, VECL/DY MILL CREEK AT MOUTH HWY DEPT 30/MO 67-73

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1967	0.0	0.0	0.0	0.0	0.0	1547.0	2092.0	1856.0	1178.0	990.0	582.0	453.0	1242.6	MCMADT67
1968	427.0	490.0	560.0	688.0	1128.0	1949.0	2269.0	1556.0	1170.0	1061.0	583.0	467.0	1029.0	MCMADT68
1969	1198.0	1284.0	1454.0	1298.0	922.0	631.0	1066.0	975.0	900.0	848.0	1102.0	1583.0	1105.1	MCMADT69
1970	426.0	667.0	678.0	660.0	1338.0	1919.0	2253.0	1748.0	1335.0	964.0	637.0	480.0	1092.1	MCMADT70
1971	498.0	681.0	715.0	829.0	1356.0	1933.0	2435.0	1347.0	1509.0	1324.0	489.0	395.0	1125.9	MCMADT71
1972	426.0	633.0	856.0	1016.0	1854.0	2305.0	2325.0	1790.0	1574.0	989.0	564.0	455.0	1232.2	MCMADT72
1973	422.0	543.0	561.0	745.0	1772.0	2556.0	2375.0	1893.0	1494.0	1452.0	689.0	0.0	1318.4	MC. .DT73
AVERAGE	566.2	716.3	804.0	872.7	1395.0	1834.3	2116.4	1595.0	1308.6	1089.7	663.7	638.8	1156.6	

FLOW, CFS.   BIG COTTONWOOD AT MOUTH - SLCWD   30/MO 30-75

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1930	22.7	24.2	29.2	101.0	140.2	139.5	44.9	35.7	35.1	41.9	27.8	24.1	55.5	BCM 030
1931	21.9	22.2	24.6	64.5	134.6	69.9	26.6	21.1	20.3	20.5	19.5	18.7	38.7	BCM 031
1932	16.9	19.3	26.8	75.2	246.8	231.4	83.5	37.0	31.5	27.6	24.9	20.5	70.1	BCM 032
1933	20.7	18.7	27.9	56.2	140.1	313.2	69.1	32.4	25.3	23.0	20.2	17.7	63.7	BCM 033
1934	16.8	17.6	29.2	65.0	79.7	26.4	14.1	13.6	11.6	12.2	15.5	17.3	26.6	BCM 034
1935	15.0	18.1	19.5	49.8	137.8	261.2	69.0	25.0	16.8	15.3	15.2	12.5	54.6	BCM 035
1936	12.9	13.8	24.1	111.7	268.7	171.5	61.5	34.1	22.7	19.3	19.2	16.1	64.6	BCM 036
1937	13.1	16.2	25.2	55.6	231.2	149.8	56.5	23.6	22.0	29.0	23.1	24.7	55.8	BCM 037
1938	17.3	17.5	30.0	99.9	222.7	227.9	66.0	32.9	23.8	23.8	23.8	21.3	67.2	BCM 038
1939	17.7	17.1	35.3	91.4	167.8	112.7	42.0	20.1	19.8	22.9	16.6	14.2	48.1	BCM 039
1940	15.4	16.9	32.6	75.1	191.6	80.2	25.5	15.3	17.7	19.1	19.5	15.4	43.7	BCM 040
1941	15.4	18.8	27.8	52.3	235.6	226.9	82.1	41.1	29.6	35.5	33.2	29.0	68.9	BCM 041
1942	25.9	26.2	34.5	113.1	191.5	257.0	93.8	34.8	26.8	23.3	23.7	22.8	72.8	BCM 042
1943	20.3	23.2	29.0	96.6	157.5	193.9	84.0	34.7	24.7	28.3	27.3	22.5	61.8	BCM 043
1944	20.3	20.3	23.1	50.6	200.4	270.6	93.1	34.8	28.4	26.1	26.9	22.4	68.1	BCM 044
1945	21.0	21.1	24.0	44.7	188.8	208.2	117.0	48.4	29.5	29.7	30.9	25.6	65.7	BCM 045
1946	25.0	22.9	35.9	143.0	200.5	170.2	61.0	31.7	26.0	33.3	34.2	29.9	67.8	BCM 046
1947	23.7	25.4	36.5	71.6	253.6	203.8	101.7	46.6	33.0	32.0	36.0	31.7	74.6	BCM 047
1948	27.2	24.1	25.5	73.2	263.9	242.3	79.0	39.3	30.9	29.7	28.6	27.2	74.2	BCM 048
1949	23.7	24.2	31.7	86.2	214.1	222.8	90.8	37.1	27.5	31.7	27.5	23.5	70.1	BCM 049
1950	23.0	23.3	26.5	71.3	186.6	248.9	107.0	41.1	32.4	29.0	32.7	29.3	70.9	BCM 050
1951	25.0	27.2	26.5	68.0	203.9	248.0	94.4	55.3	30.5	35.0	27.4	25.6	72.2	BC 051
1952	23.6	25.8	26.5	109.9	298.2	337.8	136.0	63.4	38.0	30.8	27.5	32.8	95.9	BCM 052
1953	25.6	24.1	32.9	68.2	129.0	320.9	120.1	51.2	32.1	30.2	28.3	24.4	73.9	BCM 053
1954	23.5	23.6	28.4	64.6	153.0	101.2	48.0	25.5	21.6	21.5	22.7	20.3	46.2	BCM 054
1955	19.1	18.7	20.8	45.2	200.2	197.8	63.8	31.9	21.4	19.6	22.2	28.2	57.4	BCM 055
1956	28.4	20.4	28.5	64.3	189.4	199.8	63.0	32.8	26.8	25.1	23.5	22.3	60.4	BCM 056
1957	20.9	21.7	29.7	53.2	210.9	330.2	141.6	53.5	37.2	31.0	28.1	25.7	82.0	BCM 057
1958	23.7	25.1	29.4	69.4	330.9	275.2	77.9	41.2	30.9	26.1	23.2	22.9	81.3	BCM 058
1959	20.1	21.1	23.9	56.7	134.6	213.6	55.5	29.2	30.3	33.4	24.3	20.0	55.2	BCM 059
1960	19.0	19.7	35.7	92.6	192.2	166.5	40.9	25.8	22.6	21.5	21.3	19.2	56.4	BCM 060
1961	16.5	16.2	19.8	38.7	107.7	86.1	23.1	18.5	18.7	19.9	19.5	16.2	33.4	BCM 061
1962	15.8	27.0	25.3	98.7	194.3	277.6	114.5	34.7	25.0	23.4	20.4	17.7	72.9	BCM 062
1963	16.8	18.8	19.3	39.0	170.5	222.6	62.3	26.6	27.4	21.5	22.7	19.0	55.5	BCM 063
1964	17.8	15.3	17.6	45.7	213.5	248.3	122.1	43.4	32.7	26.2	25.7	31.0	69.9	BCM 064
1965	30.2	32.2	28.3	69.8	173.8	293.4	145.1	62.1	54.3	39.2	32.8	28.7	82.5	BCM 065
1966	24.3	23.0	37.7	74.9	170.1	117.9	44.9	28.4	25.6	26.1	23.8	22.1	51.6	BCM 066
1967	20.4	22.3	30.4	31.1	196.0	263.0	145.9	36.8	19.9	26.1	25.3	21.0	69.8	BCMP 067
1968	19.6	23.3	31.7	57.8	167.9	277.0	102.4	60.5	37.9	33.9	62.5	28.2	75.2	BCMP 068
1969	30.7	31.9	42.5	69.7	254.1	327.3	119.4	54.4	44.9	42.5	39.0	34.3	90.9	BCMP 069
1970	25.5	29.0	29.0	40.2	212.2	261.9	98.9	46.2	52.5	40.4	36.6	33.3	75.5	BCMP 070
1971	36.2	35.4	39.7	91.7	207.0	306.5	107.1	49.1	43.6	39.7	38.1	33.5	85.6	BCMP 071
1972	28.8	29.9	58.1	80.5	246.2	265.5	72.7	39.5	35.2	37.6	32.6	27.8	79.5	BCMP 072
1973	26.7	24.9	29.1	51.3	260.4	257.1	81.3	44.2	41.6	36.4	35.3	31.2	76.6	BCMP 073
1974	30.3	29.5	48.0	80.6	288.6	255.7	80.6	53.7	46.0	32.6	29.1	26.4	83.4	BCM 074
1975	25.6	24.4	30.0	35.4	162.1	366.2	236.3	73.6	56.0	42.5	34.8	31.0	93.2	BCM 075
AVERAGE	22.0	22.6	29.7	70.5	198.3	222.7	84.0	38.3	30.2	28.6	27.2	24.1	66.5	

COLIF MP '100 BIG COTTON 'OD AT WATER PL' SLCWD 20/MO '0-75 ANAL: CC'D

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1930	3.0	1.0	1.0	2.0	1.0	5.0	21.0	19.0	20.0	13.0	11.0	9.0	8.8	BCAP C30
1935	4.0	3.0	8.0	5.0	7.0	9.0	14.0	15.0	18.0	9.0	5.0	5.0	8.5	BCAP C35
1940	1.0	2.0	2.0	1.0	2.0	3.0	12.0	15.0	14.0	8.0	6.0	5.0	5.9	BCAP C40
1945	2.0	2.0	1.0	0.0	3.0	7.0	10.0	13.5	6.0	6.0	4.0	2.0	4.7	BCAP 45
1946	2.0	1.0	0.0	3.0	4.5	1.0	3.0	7.0	3.0	2.0	3.0	8.0	3.0	BC 46
1947	3.0	1.0	4.0	1.0	5.0	12.0	10.0	12.0	13.0	10.0	4.0	2.0	6.4	BC. 47
AVERAGE	2.2	1.7	2.7	2.0	3.7	6.2	11.7	13.6	12.3	8.0	5.5	5.2	6.2	

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1948	6.0	4.0	3.0	5.0	10.0	12.0	10.0	21.0	30.0	6.0	12.0	45.0	13.7	BCHP 48
1949	7.0	7.0	103.0	35.0	87.0	101.0	97.0	53.0	78.0	152.0	31.0	46.0	66.4	BCHP 49
1950	32.0	27.0	20.0	48.0	87.0	59.0	84.0	74.0	285.0	207.0	171.0	108.0	100.2	BCAP 50
1951	79.0	75.0	48.0	51.0	50.0	34.0	32.0	139.0	42.0	91.0	50.0	52.0	61.9	BCHP 51
1952	26.0	26.0	6.0	18.0	57.0	28.0	65.0	223.0	118.0	26.0	30.0	20.0	53.6	BCAP 52
1953	10.0	45.0	68.0	59.0	138.0	120.0	69.0	176.0	80.0	55.0	89.0	94.0	83.6	BCAP 53
1954	67.0	25.0	45.0	38.0	40.0	58.0	64.0	88.0	75.0	35.0	36.0	13.0	48.7	BCHP 54
1955	20.0	8.5	7.0	38.0	42.0	18.0	57.0	309.0	138.0	45.5	12.0	8.0	58.6	BCHP 55
1956	13.0	8.0	10.0	91.5	389.0	25.0	40.0	102.0	65.0	102.0	3.0	3.5	71.0	BCHP 56
1957	5.0	3.0	3.0	3.0	36.0	33.0	88.0	57.0	78.0	23.0	13.0	8.0	29.2	BCAP 57
1958	2.0	7.0	6.0	6.0	85.0	201.0	33.0	50.0	253.0	66.0	28.0	32.0	64.1	BCAP 58
1959	11.0	7.0	6.0	10.0	201.0	400.0	59.0	268.0	297.0	28.0	13.0	18.0	109.8	BCAP 59
1960	9.0	9.0	15.0	30.0	26.0	26.0	47.0	49.0	13.0	10.0	15.0	3.0	21.0	BCHP 60
1961	3.0	2.0	5.0	4.0	8.0	45.0	106.0	62.0	26.0	12.0	7.0	9.0	24.1	BCAP 61
1962	8.0	12.0	6.0	11.0	79.0	65.0	100.0	163.0	88.0	63.0	48.0	39.0	57.5	BCAP 62
1963	74.0	45.0	64.0	34.0	29.0	405.0	42.0	79.0	92.0	17.0	10.0	13.0	75.3	BCHP 63
1964	16.0	10.0	13.0	17.0	20.0	45.0	54.0	46.0	26.0	9.0	19.0	19.0	24.5	BCHP 64
1965	18.0	13.0	21.0	36.0	58.0	90.0	51.0	76.0	53.0	68.0	56.0	28.0	47.3	BCHP 65
1966	9.0	19.0	19.0	14.0	29.0	27.0	55.0	29.0	38.0	27.5	20.0	36.0	26.9	BC 66
1967	47.0	31.0	46.0	56.0	65.0	38.0	64.0	110.0	36.0	36.0	25.0	23.0	48.1	BCAP1967
1968	21.0	19.0	17.0	19.0	35.0	67.0	63.0	62.0	17.0	14.0	13.0	16.0	30.2	BCAP1968
1969	18.0	15.0	13.0	19.0	45.0	129.0	107.0	113.0	78.0	71.0	68.0	58.0	61.2	BCAT1969
1970	66.0	44.0	58.0	62.0	90.0	77.0	83.0	80.0	68.0	76.0	74.0	46.0	68.7	BCAP1970
1971	70.0	49.0	54.0	62.0	69.0	82.0	149.0	170.0	114.0	113.0	87.0	61.0	90.0	BCAP1971
1972	62.0	51.0	85.0	89.0	138.0	98.0	105.0	63.0	54.0	56.0	53.0	58.0	76.0	BCAP1972
1973	23.0	45.0	47.0	42.0	59.0	71.0	90.0	90.0	51.0	36.0	46.0	77.0	56.4	BCAP1973
1974	36.0	26.0	72.0	113.0	73.0	35.0	33.0	24.0	10.0	20.0	25.0	29.0	41.3	BCM C74
1975	30.0	22.0	15.0	26.0	29.0	51.0	22.0	18.0	10.0	4.0	4.0	1.0	19.3	BCM C75
1976	1.0	3.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	BCM C76
AVERAGE	27.2	22.7	30.6	37.0	74.1	87.1	67.0	99.8	82.6	52.5	37.8	34.4	54.2	

ADT, VECL/DY BIG COTTONWOOD AT MOUTH- HWY DEPT 30/MO 55-75

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1955	330.0	328.0	302.0	270.0	713.0	1423.0	1928.0	1555.0	803.0	844.0	390.0	452.0	778.2	BCMADT55
1956	637.0	406.0	527.0	377.0	1038.0	2583.0	2688.0	1912.0	968.0	731.0	454.0	806.0	1093.9	BCMADT56
1957	781.0	930.0	749.0	660.0	770.0	1757.0	2624.0	2111.0	1379.0	1181.0	655.0	902.0	1208.2	BCMADT57
1958	669.0	748.0	560.0	573.0	922.0	1731.0	2459.0	2162.0	1188.0	1056.0	618.0	972.0	1138.2	BCMADT58
1959	854.0	844.0	1006.0	603.0	730.0	1822.0	2613.0	1924.0	1177.0	933.0	562.0	740.0	1150.7	BC .DT59
1960	1034.0	978.0	979.0	641.0	896.0	1786.0	2251.0	1724.0	1293.0	992.0	898.0	1100.0	1211.8	BCMADT60
1961	955.0	951.0	1030.0	626.0	657.0	1936.0	2435.0	1991.0	1377.0	1117.0	1151.0	1528.0	1312.8	BCMADT61
1962	1412.0	1448.0	1283.0	750.0	1025.0	1400.0	2934.0	1992.0	1596.0	1425.0	1225.0	1221.0	1400.9	BCMADT62
1963	1572.7	1898.0	1661.0	903.0	1277.0	1663.0	2890.0	2398.0	1624.0	1430.0	1259.0	1127.0	1636.0	BCMADT63
1964	1519.0	1470.0	1296.0	824.0	1229.0	1743.0	3152.0	2479.0	1715.0	1423.0	1382.0	1234.0	1622.2	BCMADT64
1965	1682.0	1700.0	1562.0	1269.0	1340.0	2049.0	2879.0	2374.0	1560.0	1372.0	1423.0	1907.0	1759.7	BCMADT65
1966	2204.0	1966.0	1601.0	879.0	1261.0	1647.0	1985.0	1756.0	1324.0	1171.0	1345.0	2013.0	1596.0	BCMADT66
1967	1766.0	1861.0	1455.0	1099.0	1093.0	1463.0	2425.0	2155.0	1551.0	1385.0	961.0	1312.0	1543.8	BCMADT67
1968	1379.0	1445.0	1420.0	1108.0	1133.0	1769.0	2759.0	2209.0	1942.0	1553.0	1268.0	1085.0	1589.2	BCMADT68
1969	1133.0	1002.0	703.0	1091.0	1332.0	1697.0	3089.0	2442.0	1840.0	1604.0	1828.0	1833.0	1632.8	BCMADT69
1970	2291.0	2446.0	1506.0	1952.0	1459.0	2002.0	3374.0	2987.0	2085.0	1873.0	2364.0	2195.0	2211.2	BCMADT70
1971	1704.0	1898.0	1846.0	1365.0	1505.0	2740.0	3594.0	2940.0	2237.0	1543.0	1960.0	1828.0	2096.7	BCMADT71
1972	2033.0	2481.0	1896.0	1306.0	1867.0	2752.0	3506.0	3026.0	2371.0	1628.0	2009.0	1955.0	2235.8	BCMADT72
1973	2065.0	2257.0	1850.0	1240.0	1755.0	2671.0	3448.0	3124.0	2217.0	1960.0	1748.0	2221.0	2213.0	BCMADT73
1974	2091.0	2342.0	1593.0	1176.0	1928.0	3221.0	3849.0	3153.0	2564.0	1790.0	1564.0	1956.0	2268.9	BC. .DT74
1975	2262.0	1987.0	1604.0	1424.0	1680.0	2296.0	3579.0	3105.0	2406.0	1833.0	1332.0	1727.0	2102.9	BCMADT75
AVERAGE	1441.6	1494.6	1258.5	958.9	1219.5	2007.2	2836.2	2358.0	1677.0	1373.5	1257.0	1434.0	1609.7	

COLIF M(/100 BIG COTTO( )OD-AT STORM MT SLC~D 4/MO 6 4/76 ANAL: C)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1968	16.0	22.0	13.0	17.0	36.0	57.0	45.0	44.0	14.0	11.0	13.0	14.0	25.2	BCSM C68
1969	18.0	18.0	9.0	14.0	58.0	69.0	74.0	61.0	40.0	73.0	41.0	51.0	43.8	BCSM C69
1970	67.0	42.0	45.0	44.0	75.0	50.0	94.0	388.0	100.0	80.0	61.0	61.0	91.7	BCSM C70
1971	55.0	74.0	53.0	100.0	97.0	85.0	125.0	156.0	101.0	108.0	80.0	61.0	91.2	BCSM C71
1972	51.0	43.0	95.0	87.0	106.0	58.0	82.0	28.0	34.0	78.0	29.0	26.0	59.7	BCSM C72
1973	23.0	30.0	32.0	29.0	56.0	31.0	54.0	39.0	52.0	43.0	47.0	54.0	40.8	BCSM C73
1974	32.0	33.6	50.7	77.1	62.5	38.0	31.2	36.9	19.9	30.0	33.5	28.8	39.5	BCSM C74
1975	15.7	25.7	32.4	25.6	33.8	42.1	24.2	28.5	13.0	7.5	4.5	1.5	21.2	BCSM C75
1976	1.3	4.0	8.4	81.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.7	BCSM C76
AVERAGE	30.2	32.5	37.6	52.7	65.5	53.8	66.2	97.7	46.7	53.8	38.6	37.2	50.5	

COLIF MPN/100 BIG COTTONWOOD-MILL D/RYNLD-SLCWD 4/MO 67-4/76 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1967	37.0	24.0	22.0	18.0	38.0	107.0	102.0	66.0	109.0	29.0	32.0	23.0	50.6	BCRF C67
1968	14.0	12.0	9.0	29.0	55.0	93.0	58.0	65.0	40.0	75.0	28.0	8.0	40.5	BCRF C68
1969	23.0	21.0	10.0	39.0	65.0	77.0	86.0	102.0	41.0	50.0	140.0	19.0	56.1	BCRF C69
1970	70.0	21.0	77.0	38.0	200.0	114.0	105.0	214.0	130.0	113.0	150.0	49.0	106.7	BCRF C70
1971	115.0	59.0	45.0	49.0	75.0	128.0	190.0	189.0	173.0	56.0	86.0	82.0	103.9	BCRF C71
1972	79.0	74.0	55.0	104.0	163.0	77.0	93.0	39.0	25.0	143.0	103.0	19.0	81.2	BCRF C72
1973	17.0	32.0	26.0	29.0	34.0	47.0	49.0	121.0	117.0	130.0	125.0	94.0	67.8	BCRF C73
1974	52.5	45.0	76.0	45.0	96.0	37.0	40.5	38.8	25.0	28.0	54.3	29.3	47.3	BCMD C74
1975	32.7	14.3	33.8	11.3	63.0	32.4	51.0	45.0	19.3	3.8	20.5	1.3	27.4	BCMD C75
1976	0.1	3.0	3.4	28.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.6	BCMD C76
AVERAGE	43.3	30.5	35.7	39.0	87.7	79.2	86.1	97.8	75.5	69.8	82.1	36.1	62.6	

COLIF MPN/100 BIG COTTONWOOD AT SLVR FORK-SLCWD 4/MO 59-4/76 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1969	0.0	2.0	3.0	33.0	102.0	80.0	119.0	156.0	49.0	34.0	50.0	46.0	61.3	BCSF C69
1970	82.0	32.0	49.0	102.0	152.0	77.0	130.0	170.0	68.0	71.0	77.0	37.0	87.2	BCSF C70
1971	109.0	86.0	54.0	71.0	86.0	36.0	151.0	110.0	83.0	41.0	42.0	25.0	74.5	BCSF C71
1972	49.0	18.0	38.0	102.0	227.0	50.0	73.0	48.0	38.0	115.0	46.0	27.0	69.2	BCSF C72
1973	11.0	29.0	26.0	49.0	50.0	22.0	70.0	134.0	28.0	76.0	172.0	64.0	60.9	BCSF C73
1974	30.3	24.7	21.0	45.0	41.0	22.8	42.3	33.0	27.0	9.7	49.3	32.0	31.5	BCSF C74
1975	7.7	18.0	47.8	35.0	143.0	58.0	54.5	82.0	22.7	9.3	0.8	1.5	40.0	BCSF C75
1976	1.5	25.5	5.4	20.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.2	BCSF C76
AVERAGE	41.5	29.4	30.5	57.2	114.4	49.4	91.4	104.7	45.1	50.9	62.4	33.2	58.5	

COLIF MPN/100 BIG COTTONWOOD AT BRIGHTON- SLCWD 4/ 6/67-4/76 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1967	0.0	0.0	0.0	0.0	0.0	74.0	109.0	54.0	77.0	46.0	114.0	0.0	79.0	BCBR C67
1968	77.0	11.0	4.0	6.0	78.0	172.0	83.0	117.0	81.0	78.0	87.0	23.0	68.1	BCBR C68
1969	7.0	0.0	0.0	38.0	213.0	211.0	64.0	94.0	45.0	62.0	48.0	30.0	81.2	BCBR C69
1970	63.0	27.0	57.0	100.0	76.0	59.0	97.0	188.0	119.0	167.0	20.0	56.0	85.7	BCBR C70
1971	129.0	62.0	59.0	125.0	184.0	84.0	143.0	548.0	208.0	137.0	43.0	41.0	146.9	BCBR C71
1972	33.0	35.0	53.0	158.0	117.0	55.0	145.0	35.0	30.0	96.0	113.0	0.0	79.1	BCBR C72
1973	10.0	5.0	75.0	43.0	24.0	132.0	44.0	53.0	107.0	129.0	47.0	69.0	61.5	BCBR C73
1974	48.3	15.0	88.3	65.8	81.5	40.3	35.3	29.0	0.0	12.7	42.0	29.7	44.4	BCBR C74
1975	29.7	33.5	186.0	84.3	282.5	123.0	381.8	125.0	11.7	10.5	2.0	2.0	106.0	BCBR C75
1976	5.3	15.0	9.8	18.5	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	12.2	BCBR C76
AVERAGE	44.7	25.4	66.5	71.0	132.0	105.6	122.5	138.1	84.8	82.0	57.3	35.8	81.5	

FLOW, CFS   LITTLE COTTWD AT WAS RES - SLCAD   30/MO 30-75

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1930	9.8	11.0	13.2	77.4	132.6	175.1	46.5	26.7	19.7	27.9	14.6	15.0	47.5	LCM 030
1931	10.1	10.3	13.4	35.2	156.9	96.4	24.7	16.9	9.6	8.7	8.5	10.0	33.4	LCM 031
1932	11.0	12.1	14.4	39.6	236.4	289.6	131.4	37.7	20.2	15.7	15.6	15.2	67.4	LCM 032
1933	13.9	13.8	12.9	27.4	141.2	247.0	67.8	30.6	17;3	14.3	13.7	11.5	47.6	LCM 033
1934	7.8	10.0	16.0	57.9	133.4	36.8	15.4	12.8	11.1	11.9	12.5	11.9	28.1	LCM 034
1935	11.9	14.7	15.7	31.1	128.4	270.1	110.4	30.8	17.5	14.8	12.6	10.2	55.7	LCM 035
1939	14.0	13.5	22.0	83.9	238.2	200.4	69.8	28.9	22.3	21.4	15.1	12.3	61.8	LCM 039
1940	11.1	12.2	18.5	66.1	268.2	136.8	33.3	19.5	15.3	16.3	14.8	13.2	52.1	LCM 040
1941	12.6	14.2	19.7	34.6	231.4	277.2	144.1	46.3	26.4	25.3	24.2	21.1	73.1	LCM 041
1942	18.4	17.2	15.1	86.0	158.1	253.6	128.1	29.4	19.2	16.3	14.7	13.7	64.2	LCM 042
1943	13.1	13.7	15.5	49.5	162.9	189.8	108.5	31.2	21.3	21.1	19.4	17.3	55.3	LCM 043
1944	15.3	14.1	13.3	27.4	172.9	261.1	142.6	28.1	19.5	18.5	18.0	13.2	62.0	LCM 044
1945	11.7	13.7	14.5	22.5	177.2	244.0	157.5	70.0	27.0	24.4	20.9	16.4	66.6	LCM 045
1946	14.9	14.5	20.5	74.6	130.2	139.7	73.8	29.3	18.9	23.3	23.0	18.7	46.0	LCM 046
1947	15.2	16.2	22.2	50.3	170.3	151.1	122.4	50.9	26.6	23.1	21.5	19.2	55.7	LCM 047
1948	17.0	17.1	16.4	33.2	179.6	284.0	108.7	36.0	22.3	20.0	14.7	13.3	63.5	LCM 048
1949	11.3	9.2	16.3	61.2	216.5	278.2	123.7	37.7	24.5	19.3	19.9	16.2	67.8	LCM 049
1950	13.7	12.8	16.3	52.9	166.9	293.5	131.0	38.6	25.8	18.2	17.2	17.0	67.0	LCM 050
1951	13.7	13.1	14.4	43.1	175.3	247.5	97.6	53.2	26.4	20.4	15.8	13.8	61.2	LCM 051
1952	12.5	13.6	13.4	53.8	266.2	366.7	170.4	56.3	30.5	19.9	15.7	14.2	86.1	LCM 052
1953	14.4	13.2	16.5	32.6	135.1	353.7	132.0	39.4	24.2	18.0	17.7	15.8	65.2	LCM 053
1954	14.7	15.9	19.1	44.8	184.1	138.7	64.3	31.8	20.0	16.4	15.9	14.0	48.3	LCM 054
1955	12.4	13.2	13.8	21.4	165.6	256.8	64.6	37.3	21.7	15.8	14.2	15.9	54.4	LCM 055
1956	17.9	15.8	15.5	35.2	190.0	253.0	71.9	37.8	20.8	14.9	13.3	12.0	58.5	LC 056
1957	12.7	11.5	13.3	23.8	106.9	296.8	137.5	44.2	27.0	17.0	13.0	11.8	59.5	LCM 057
1958	10.0	13.6	13.3	27.2	231.6	289.4	79.7	37.1	23.9	17.1	14.2	13.7	64.2	LCM 058
1959	12.6	11.1	12.3	29.5	97.1	237.7	55.1	24.8	23.4	24.7	18.8	15.1	46.8	LCM 059
1960	13.1	12.6	20.8	54.8	165.3	223.1	64.0	26.5	17.0	15.1	13.0	13.1	51.5	LCM 060
1961	10.5	9.7	11.6	22.5	162.0	108.0	24.5	18.0	21.1	18.4	18.0	15.4	36.6	LCWR 061
1962	14.3	14.5	17.3	68.0	151.0	289.0	146.0	44.9	21.3	17.2	16.7	12.4	67.7	LCWR 062
1963	11.4	12.4	12.8	18.9	150.0	246.0	121.0	31.9	22.1	19.6	18.2	15.0	56.6	LCWR 063
1964	13.2	12.3	13.3	18.0	180.0	291.0	133.0	29.9	24.9	17.6	16.9	17.0	63.9	LCWR 064
1965	16.3	16.0	17.4	28.1	144.0	348.0	237.0	83.6	37.1	28.3	20.0	19.2	82.9	LCWR 065
1966	15.9	14.3	17.7	53.0	168.0	144.0	48.0	24.1	17.4	16.1	14.9	12.5	45.5	LCWR 066
1967	12.4	13.2	15.9	22.2	148.4	348.8	236.5	50.7	31.1	21.2	16.7	13.5	75.0	LCWR 067
1968	12.1	13.4	32.3	29.6	138.5	370.6	125.7	62.7	39.7	26.8	27.5	20.7	74.8	LCWR 068
1969	19.8	18.1	19.1	74.9	319.0	279.0	162.0	56.0	33.0	22.0	19.0	16.0	86.5	LCWR 069
1970	14.8	16.2	16.6	22.9	162.5	301.7	121.2	40.9	38.7	24.7	24.7	36.1	68.4	LCWR 070
1971	22.2	22.1	22.3	60.2	163.7	327.0	134.2	47.4	37.6	25.6	24.4	21.7	75.7	LC.. 071
1972	18.6	16.5	27.2	45.0	197.0	269.3	69.7	58.9	27.0	35.4	25.7	20.6	67.6	LCWR 072
1973	16.7	16.1	18.0	28.0	228.7	344.2	135.5	52.0	37.9	30.6	30.4	22.4	80.0	LCWR 073
1974	19.3	17.5	23.5	35.7	240.7	294.9	87.2	41.1	24.8	20.1	17.3	14.8	69.7	LCM 074
1975	17.1	15.9	14.9	17.8	89.7	348.8	352.4	80.6	43.1	27.4	24.0	18.6	87.5	LCM 075
AVERAGE	13.9	14.0	16.9	42.4	172.9	250.6	110.2	39.8	24.6	20.3	17.8	15.8	61.6	

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1931	2.0	0.0	0.0	0.0	3.0	8.9	22.0	16.9	18.5	17.5	11.2	13.3	15.5	LCM C31
1932	7.6	10.2	6.1	5.6	13.8	6.2	9.8	17.1	7.0	5.4	1.8	2.4	7.7	LCM C32
1933	7.0	16.7	8.1	13.8	8.3	8.6	9.8	17.1	6.5	3.5	8.1	13.9	10.1	LCM C33
1934	5.2	16.0	10.7	6.2	0.0	0.2	12.6	9.4	10.6	9.2	6.4	5.9	7.7	LCM C34
1935	2.7	1.1	1.1	1.3	1.1	4.2	6.0	1.4	5.8	5.1	1.6	0.0	2.3	LCM C35
1936	2.2	4.1	1.8	5.9	5.1	0.8	1.3	8.7	8.5	2.7	10.9	1.3	4.5	LCM C36
1937	2.3	7.4	2.2	0.7	5.1	0.0	3.1	10.3	16.1	12.1	3.6	7.6	6.4	LCM C37
1938	6.1	5.1	5.1	5.4	0.0	2.4	3.6	4.7	6.1	12.6	14.8	2.2	6.2	LCM C38
1939	6.1	9.9	3.3	5.1	0.0	8.4	1.1	5.1	14.7	3.1	0.5	0.0	5.2	LCM C39
1940	0.0	0.7	1.4	2.4	4.7	3.5	2.3	9.2	9.2	4.1	1.0	2.4	3.4	LC C40
1941	1.0	0.6	1.7	0.5	2.4	3.6	6.9	9.3	1.6	3.5	4.6	2.2	3.2	LCM C41
1942	2.7	1.1	2.5	0.0	0.4	5.3	3.9	15.1	7.6	4.7	0.7	0.0	3.7	LCM C42
1943	2.8	0.7	1.6	2.8	1.8	1.8	2.3	8.9	9.9	7.1	3.1	2.2	3.7	LCM C43
1944	0.0	0.0	4.1	0.5	4.1	1.8	3.1	11.6	14.7	4.5	1.3	0.7	3.9	LCM C44
1945	1.1	3.1	5.8	1.3	1.1	4.7	1.1	5.5	6.1	2.4	2.8	1.5	3.0	LCM C45
1946	0.6	0.0	0.4	1.4	0.9	0.5	1.1	0.9	3.6	4.0	2.7	5.4	1.8	LCM C46
1947	0.0	0.5	1.3	2.8	5.8	9.9	3.2	7.5	4.6	7.5	3.1	3.6	4.1	LCM C47
1948	3.8	1.2	1.8	2.2	5.0	2.8	5.4	4.3	6.4	6.6	2.3	2.3	3.7	LCM C48
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AVERAGE	3.0	4.6	3.5	3.4	4.0	4.1	5.5	9.1	8.7	6.4	4.5	3.7	5.1	

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1951	22.0	15.0	14.0	39.0	11.0	5.0	3.0	21.0	21.0	17.5	38.7	14.0	18.4	LCM C51
1954	12.0	11.0	10.0	6.5	11.0	8.7	12.0	12.0	27.5	40.5	12.0	3.5	13.9	LCM C54
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AVERAGE	17.0	13.0	12.0	22.7	11.0	6.8	7.5	16.5	24.2	29.0	25.4	8.7	16.2	

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1960	9.0	8.0	15.0	3.0	3.0	2.0	2.0	5.0	5.0	2.0	6.0	1.0	5.1	LCM--C60
1961	1.0	2.0	1.0	1.0	2.0	6.0	1.0	3.0	4.0	5.0	3.0	3.0	2.7	LCM C61
1962	2.0	3.0	1.0	1.0	4.0	15.0	9.0	21.0	36.0	6.0	5.0	3.0	8.8	LCM C62
1963	2.0	3.0	3.0	2.0	11.0	4.0	6.0	10.0	7.0	3.0	1.0	0.0	4.7	LC C63
1964	1.0	1.0	1.0	1.0	7.0	3.0	5.0	5.0	3.0	2.0	2.0	2.0	2.7	LCM C64
1965	3.0	2.0	4.0	3.0	8.0	8.0	7.0	8.0	14.0	13.0	20.0	12.0	8.5	LCM C65
1966	4.0	1.0	17.0	66.0	9.0	3.0	3.0	6.0	5.0	7.0	9.0	8.0	11.5	LCM C66
1967	11.0	6.0	10.0	14.0	12.0	9.0	5.0	9.0	11.0	10.0	4.0	1.0	8.5	LCM C67
1968	4.0	4.0	3.0	6.0	11.0	14.0	8.0	14.0	8.0	3.0	6.0	5.0	7.2	LCM C68
1969	17.0	13.0	18.0	15.0	13.0	7.0	27.0	16.0	6.0	15.0	10.0	7.0	13.7	LCM C69
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AVERAGE	5.4	4.3	7.3	11.2	8.0	7.1	7.3	9.7	9.9	6.6	6.6	4.7	7.4	

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1970	13.0	7.0	11.0	14.0	31.0	36.0	65.0	69.0	37.0	37.0	53.0	34.0	33.9	LCM C70
1971	61.0	33.0	40.0	39.0	57.0	41.0	34.0	70.0	83.0	70.0	88.0	86.0	58.5	LCM C71
1972	44.0	43.0	59.0	62.0	102.0	54.0	91.0	63.0	43.0	47.0	159.0	32.0	66.6	LC. C72
1973	29.0	16.0	22.0	22.0	44.0	48.0	60.0	67.0	67.0	36.0	62.0	44.0	43.1	LCMP C73
1974	22.0	24.0	30.0	103.0	52.0	39.0	48.0	37.0	20.0	30.0	36.0	40.0	40.1	LCM C74
1975	26.0	14.0	23.0	17.0	13.0	[illegible]	30.0	61.0	60.0	43.0	11.0	22.0	28.8	LCM C75
1976	11.0	5.0	37.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.7	LCM C76
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AVERAGE	29.4	20.3	31.7	42.8	49.8	40.7	54.7	61.2	51.7	43.8	68.2	43.0	44.1	

COL'F MPN/100 LI'TLE COTTNWD 'T WATER PLT- MWD 20/M' 61-75

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1961	0.0	18.0	41.0	16.0	10.0	43.0	59.0	68.0	127.0	44.0	17.0	7.0	40.9	LCWP C61
1962	9.0	15.0	14.0	19.0	21.0	25.0	90.0	68.0	22.0	12.0	14.0	4.0	26.1	LCWP C62
1963	13.0	17.0	22.0	27.0	27.0	61.0	86.0	85.0	89.0	31.0	23.0	28.0	42.4	LCWP C63
1964	27.0	26.0	39.0	105.0	74.0	78.0	220.0	95.0	50.0	20.0	14.0	22.0	64.2	LCWP C64
1965	9.0	9.0	25.0	12.0	33.0	31.0	21.0	34.0	52.0	20.0	29.0	23.0	24.8	LCWP C65
1966	18.0	10.0	41.0	37.0	22.0	105.0	52.0	139.0	79.0	36.0	27.0	19.0	48.0	LCWP C66
1967	21.0	15.0	18.0	49.0	69.0	18.0	65.0	106.0	132.0	85.0	29.0	27.0	52.8	LCWP*C67
1968	13.0	12.0	17.0	42.0	35.0	71.0	138.0	125.0	84.0	116.0	32.0	25.0	59.2	LCWP*C68
1969	38.0	33.0	50.0	35.0	68.0	31.0	51.0	154.0	196.0	78.0	67.0	30.0	69.2	LCWP*C69
AVERAGE	18.5	17.2	29.7	38.0	39.9	51.4	86.9	96.1	92.3	49.1	28.0	20.6	47.6	

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1970	33.0	26.0	40.0	33.0	64.0	114.0	127.0	287.0	242.0	134.0	79.0	88.0	105.6	LCWP*C70
1971	142.0	75.0	47.0	58.0	111.0	279.0	198.0	389.0	371.0	310.0	128.0	219.0	193.9	LCWP*C71
1972	122.0	149.0	261.0	56.0	142.0	112.0	327.0	296.0	396.0	491.0	593.0	258.0	266.9	LCWP*C72
1973	217.0	65.0	70.0	102.0	1778.0	315.0	538.0	594.0	252.0	167.0	181.0	91.0	364.2	LCWP*C73
1974	61.0	104.0	124.0	307.0	366.0	172.0	509.0	808.0	398.0	479.0	229.0	303.0	321.7	LCWP*C74
1975	203.0	217.0	94.0	121.0	194.0	171.0	126.0	163.0	210.0	289.0	137.0	57.0	165.2	LCWP*C75
1976	45.0	34.0	38.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.0	LCWP*C76
AVERAGE	117.6	95.7	96.3	112.8	442.5	193.8	304.2	422.8	311.5	311.7	224.5	169.3	228.3	

COLIF MPN/100 LITTLE COTTNWD AT WATER PLT- MWD 20/MO 67-74 MEDIAN

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1967	17.0	14.0	17.0	27.0	44.0	17.0	33.0	79.0	75.0	44.0	22.0	17.0	33.8	LCWP,C67
1968	13.0	11.0	16.0	16.0	33.0	33.0	59.0	95.0	49.0	42.0	17.0	17.0	33.4	LCWP,C68
1969	22.0	25.0	24.0	23.0	34.0	23.0	26.0	87.0	170.0	52.0	49.0	22.0	46.4	LC ,C69
1970	14.0	14.0	24.0	26.0	70.0	49.0	79.0	100.0	110.0	57.0	70.0	79.0	57.7	LCWP,C70
1971	60.0	64.0	33.0	33.0	49.0	180.0	155.0	180.0	280.0	180.0	140.0	135.0	124.1	LCWP,C71
1972	79.0	38.0	110.0	49.0	130.0	95.0	240.0	220.0	180.0	220.0	675.0	170.0	183.8	LCWP,C72
1973	155.0	52.0	46.0	87.0	260.0	210.0	280.0	220.0	180.0	140.0	125.0	48.0	150.2	LCWP,C73
1974	49.0	48.0	70.0	125.0	200.0	130.0	350.0	410.0	250.0	0.0	0.0	0.0	181.3	LCWP,C74
AVERAGE	51.1	33.2	42.5	48.2	102.5	92.1	152.7	173.9	161.7	105.0	156.9	69.7	98.8	

COLIF MF#/100 LITTLE COTTNWD AT WATER PLT- MWD 20/MO 67-75 M-FILTER

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1967	17.0	13.0	12.0	21.0	30.0	10.0	31.0	65.0	72.0	35.0	26.0	21.0	29.4	LCWP+C67
1968	11.0	12.0	6.0	11.0	15.0	16.0	10.0	21.0	40.0	36.0	13.0	6.0	16.4	LCWP+C68
1969	10.0	5.0	6.0	15.0	24.0	16.0	16.0	42.0	79.0	26.0	11.0	9.0	21.6	LCWP+C69
1970	6.0	10.0	11.0	10.0	9.0	32.0	68.0	96.0	60.0	32.0	31.0	30.0	32.9	LCWP+C70
1971	14.0	14.0	12.0	17.0	23.0	27.0	25.0	67.0	72.0	62.0	23.0	12.0	30.7	LCWP+C71
1972	12.0	3.0	13.0	10.0	32.0	26.0	114.0	89.0	63.0	82.0	66.0	29.0	44.9	LCWP+C72
1973	18.0	15.0	12.0	17.0	22.0	32.0	110.0	95.0	119.0	73.0	40.0	18.0	47.6	LCWP+C73
1974	19.0	8.0	10.0	25.0	18.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

COL[illegible] MPN/100 LI[illegible]LE COTTNWD [illegible] WAS BLVD- [illegible]TATE 1/MO 66-74 VOIDS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1966	0.0	0.0	0.0	230.0	0.0	1500.0	930.0	930.0	2300.0	930.0	4300.0	930.0	1506.2	LCMS C66
1967	230.0	230.0	91.0	91.0	2300.0	91.0	430.0	930.0	430.0	230.0	230.0	1500.0	565.2	LCMS C67
1968	9300.0	230.0	0.0	0.0	0.0	230.0	930.0	230.0	930.0	0.0	0.0	0.0	1975.0	LC[illegible] C68
1969	0.0	0.0	0.0	230.0	93.0	23.0	230.0	230.0	0.0	0.0	0.0	0.0	161.2	LC[illegible] C69
1970	0.0	0.0	0.0	0.0	230.0	930.0	230.0	0.0	0.0	0.0	0.0	0.0	463.3	LCMS C70
1971	0.0	4.0	43.0	0.0	0.0	0.0	93.0	23.0	0.0	0.0	0.0	0.0	40.7	LCMS C71
1972	0.0	0.0	0.0	21.0	43.0	43.0	0.0	0.0	0.0	43.0	0.0	0.0	37.5	LCMS C72
1973	0.0	0.0	0.0	93.0	0.0	0.0	0.0	210.0	0.0	43.0	0.0	0.0	115.3	LCMS C73
1974	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	LCMS C74
AVERAGE	4765.0	154.7	67.0	133.0	534.0	469.5	473.8	425.5	1220.0	311.5	2265.0	1215.0	729.2	

COLIF MPN/100 LITTLE COTTNWD AT PWR PLNT- STATE 1/MO 66-71 VOIDS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1966	0.0	0.0	0.0	230.0	0.0	230.0	230.0	91.0	230.0	430.0	0.0	2300.0	534.4	LCPP C66
1967	91.0	30.0	230.0	91.0	230.0	230.0	230.0	230.0	230.0	91.0	230.0	430.0	195.2	LCPP C67
1968	1500.0	930.0	0.0	0.0	0.0	230.0	0.0	230.0	230.0	230.0	230.0	230.0	476.2	LCPP C68
1969	230.0	230.0	0.0	93.0	43.0	93.0	430.0	930.0	930.0	43.0	23.0	23.0	278.9	LCPP C69
1970	2300.0	230.0	0.0	0.0	230.0	930.0	230.0	0.0	0.0	0.0	0.0	0.0	653.3	LCPP C70
1971	0.0	4.0	43.0	0.0	0.0	0.0	23.0	9.0	0.0	21.0	0.0	43.0	23.8	LCPP C71
AVERAGE	1030.2	284.8	136.5	103.5	167.7	342.6	228.6	298.0	405.0	163.0	161.0	605.2	340.5	

TDS, MGL/100 LITTLE COTTNWD AT WATER PLT-SLCWD 2/MO 61-75 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1961	136.0	131.0	135.0	132.0	95.0	72.0	98.0	124.0	128.0	125.0	126.0	134.0	119.7	LCMTDS61
1962	131.0	132.0	132.0	132.0	84.0	78.0	69.0	93.0	119.0	119.0	130.0	139.0	113.2	LCMTDS62
1963	126.0	138.0	130.0	142.0	120.0	89.0	70.0	102.0	118.0	128.0	126.0	129.0	118.2	LCMTDS63
1964	134.0	138.0	137.0	140.0	126.0	78.0	66.0	96.0	110.0	135.0	134.1	6.0	108.3	LCMTDS64
1965	135.0	135.0	139.0	133.0	124.0	74.0	51.0	85.0	105.0	109.0	129.0	134.0	112.7	LCMTDS65
1966	135.0	156.0	141.0	134.0	92.0	66.0	87.0	106.0	151.0	133.0	143.0	141.0	123.7	LC[illegible]TDS66
1967	141.0	145.0	145.0	152.0	0.0	85.0	75.0	90.0	103.0	126.0	139.0	145.0	122.4	LC[illegible]DS67
1968	141.0	148.0	143.0	137.0	121.0	74.0	71.0	102.0	99.0	121.0	120.0	132.0	117.4	LCWPTD68
1969	136.0	138.0	137.0	137.0	105.0	68.0	66.0	95.0	109.0	177.0	163.0	146.0	123.1	LCWPTD69
1970	131.0	77.0	147.0	159.0	0.0	74.0	74.0	118.0	109.0	199.0	133.0	144.0	124.1	LCMTDS70
1971	139.0	137.0	215.0	132.0	118.0	103.0	78.0	183.0	101.0	151.0	149.0	132.0	136.5	LCWPTD71
1972	138.0	152.0	168.0	150.0	116.0	171.0	97.0	92.0	122.0	176.0	157.0	145.0	140.3	LCWPTD72
1973	148.0	145.0	130.0	207.0	126.0	96.0	72.0	93.0	124.0	130.0	120.0	141.0	127.7	LCWPTD73
1974	151.0	158.0	158.0	151.0	0.0	71.0	79.0	130.0	122.0	134.0	145.0	147.0	131.5	LCWPTD74
1975	162.0	154.0	245.0	150.0	119.0	108.0	69.0	188.0	92.0	129.0	143.0	141.0	141.7	LCWPTD75
1976	146.0	0.0	179.0	142.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	155.7	LCWPTD76
AVERAGE	139.4	138.9	155.1	145.6	112.2	87.1	74.8	113.1	114.1	139.5	137.1	130.4	124.5	

ADT, VECL/DY LITTLE COTTNWD AT MOUTH- HWY DEPT 30/MO 48-75

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1948	287.0	245.0	256.0	185.0	144.0	188.0	268.0	236.0	191.0	221.0	324.0	202.0	228.9	LCMADT48
1949	190.0	130.0	187.0	201.0	137.0	175.0	283.0	211.0	199.0	212.0	201.0	213.0	194.9	LCMADT49
1950	222.0	235.0	195.0	170.0	158.0	214.0	312.0	228.0	212.0	211.0	281.0	319.0	229.7	LCMADT50
1951	240.0	336.0	177.0	94.0	66.0	142.0	288.0	246.0	217.0	157.0	104.0	130.0	183.1	LCMADT51
1952	58.0	63.0	61.0	25.0	35.0	190.0	198.0	164.0	145.0	138.0	82.0	147.0	108.8	LCMADT52
1953	229.0	223.0	132.0	115.0	90.0	127.0	295.0	171.0	167.0	170.0	201.0	223.0	178.6	LCMADT53
1954	257.0	334.0	256.0	186.0	159.0	201.0	355.0	258.0	201.0	206.0	247.0	410.0	255.8	LCMADT54
1955	315.0	345.0	267.0	214.0	154.0	222.0	347.0	308.0	237.0	306.0	295.0	326.0	278.0	LCMADT55
1956	380.0	315.0	372.0	222.0	191.0	279.0	369.0	267.0	267.0	218.0	218.0	439.0	294.7	LCMADT56
1957	373.0	485.0	383.0	289.0	172.0	221.0	353.0	342.0	266.0	234.0	288.0	414.0	318.3	LCMADT57
1958	467.0	405.0	353.0	247.0	277.0	315.0	422.0	407.0	363.0	267.0	232.0	478.0	352.7	LCMADT58
1959	686.0	643.0	677.0	585.0	276.0	490.0	682.0	553.0	430.0	463.0	392.0	654.0	544.2	LCMADT59
1960	735.0	624.0	673.0	446.0	356.0	376.0	486.0	458.0	413.0	390.0	448.0	754.0	513.2	LCMADT60
1961	748.0	646.0	647.0	343.0	268.0	506.0	647.0	547.0	473.0	401.0	750.0	878.0	571.2	LCMADT61
1962	860.0	773.0	791.0	573.0	382.0	550.0	736.0	692.0	517.0	338.0	390.0	526.0	594.0	LCMADT62
1963	882.0	930.0	863.0	530.0	337.0	417.0	678.0	568.0	446.0	475.0	749.0	930.0	650.4	LCMADT63
1964	1014.0	767.0	860.0	438.0	310.0	431.0	701.0	626.0	470.0	441.0	709.0	748.0	626.2	LC DT64
1965	1136.0	966.0	908.0	379.0	297.0	421.0	538.0	551.0	553.0	445.0	718.0	815.0	643.9	LCMADT65
1966	766.0	886.0	651.0	483.0	410.0	455.0	647.0	592.0	539.0	536.0	857.0	1075.0	658.1	LCMADT66
1967	1028.0	859.0	985.0	671.0	425.0	464.0	762.0	714.0	581.0	621.0	654.0	1185.0	745.7	LCMADT67
1968	1175.0	961.0	868.0	811.0	357.0	523.0	762.0	625.0	618.0	638.0	1473.0	1538.0	862.4	LCMADT68
1969	476.0	494.0	623.0	620.0	1114.0	1489.0	1978.0	1566.0	1237.0	846.0	477.0	416.0	944.7	LCMADT69
1970	1218.0	1466.0	1564.0	1132.0	579.0	889.0	1086.0	1047.0	943.0	967.0	1382.0	1646.0	1159.9	LCMADT70
1971	1249.0	1620.0	1336.0	1398.0	810.0	1166.0	1272.0	1239.0	1368.0	1126.0	2048.0	2076.0	1392.3	LCMADT71
1972	2515.0	3003.0	3060.0	1976.0	875.0	1362.0	1966.0	2124.0	2145.0	1660.0	2674.0	3435.0	2232.9	LCMADT72
1973	3533.0	3698.0	3528.0	2778.0	1430.0	1796.0	2130.0	2278.0	2071.0	1972.0	2731.0	2836.0	2565.1	LCMADT73
1974	3102.0	3585.0	3206.0	2252.0	1181.0	1882.0	2404.0	2420.0	2355.0	1919.0	2377.0	3671.0	2529.5	LCMADT74
1975	4044.0	4303.0	3570.0	3160.0	949.0	1875.0	2656.0	2590.0	2337.0	1994.0	2267.0	4237.0	2831.8	LCMADT75
AVERAGE	1006.6	1047.9	980.3	733.0	426.4	620.2	843.6	786.7	712.9	627.6	841.7	1097.2	810.3	

CL, MGL/100 LITTLE COTTNWD AT WATER PLT-SLCWD 2/MO 61-75 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1961	3.7	3.5	3.9	4.5	6.2	2.9	6.8	4.8	4.6	3.7	6.6	4.5	4.6	LCM CL61
1962	4.7	4.2	6.1	4.6	5.5	3.5	2.4	3.4	3.4	4.7	4.3	3.8	4.2	LCM CL62
1963	3.8	4.9	4.4	5.7	8.1	3.9	3.0	4.1	3.9	6.0	4.2	4.6	4.7	LCM CL63
1964	4.8	5.1	5.1	7.9	9.8	3.9	2.6	4.2	4.7	5.5	5.4	5.7	5.4	LCM CL64
1965	6.5	6.1	7.3	9.0	11.2	6.2	1.7	3.5	4.3	3.9	5.2	5.1	5.8	LC CL65
1966	5.8	7.2	6.2	13.2	4.5	3.3	3.3	4.3	7.9	5.1	5.4	5.7	6.0	LCM CL66
1967	5.8	6.8	8.0	15.5	0.0	5.6	3.7	4.5	4.8	7.4	7.0	7.4	7.0	LCM CL67
1968	7.1	7.2	10.4	19.4	19.5	6.6	4.2	6.3	5.7	7.6	8.0	7.3	9.1	LCM CL68
1969	8.0	9.4	10.9	21.5	13.0	3.1	2.6	4.2	3.9	4.0	6.7	7.2	7.9	LCM CL69
1970	7.2	8.5	11.6	11.7	9.0	3.8	4.1	5.1	5.1	9.2	7.5	8.5	7.6	LCM CL70
1971	8.1	0.0	11.3	0.0	13.8	9.3	4.4	5.6	4.4	8.2	7.5	7.6	8.0	LCM CL71
1972	8.7	7.9	15.0	14.0	15.0	5.2	6.3	6.4	5.9	12.0	7.8	9.5	9.5	LCM CL72
1973	9.1	10.1	10.4	10.8	28.0	7.2	5.4	7.5	6.5	8.5	9.6	9.2	10.2	LCWPCL73
1974	8.2	8.3	8.0	7.7	8.0	6.2	6.9	8.7	0.0	0.0	0.0	0.0	7.8	LCWPCL74
1975	10.9	10.8	13.1	9.0	8.5	9.2	4.6	8.4	7.4	9.3	9.3	9.9	9.2	LCWPCL75
1976	10.0	0.0	12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	LCWPCL76
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AVERAGE	7.0	7.1	9.0	11.0	11.4	5.3	4.1	5.4	5.2	6.8	6.8	6.9	7.2	

SI02 MGL/100 LITTLE COTTNWD AT WATER PLT-SLCWD 2/MO 61-75 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1961	6.9	8.2	8.1	8.1	6.4	4.9	6.3	7.6	5.9	6.8	7.1	7.5	7.0	LCM SI61
1962	7.1	6.7	6.6	7.1	6.1	4.4	5.1	0.0	0.0	0.0	8.4	7.4	6.5	LCM SI62
1963	7.3	8.0	7.8	7.3	8.0	5.5	4.5	6.1	6.1	11.0	7.4	7.5	7.2	LCM SI63
1964	15.9	6.8	7.1	7.8	7.1	6.5	5.6	7.3	9.4	13.2	7.2	7.4	8.4	LC SI64
1965	7.6	10.7	8.8	7.9	6.5	9.3	5.0	5.1	5.3	5.0	7.6	7.7	7.2	LCM SI65
1966	7.8	9.3	8.1	7.5	5.7	5.3	5.3	7.3	4.9	6.5	6.9	6.9	6.8	LCM SI66
1967	6.6	6.3	6.1	5.5	0.0	4.0	3.2	4.9	3.3	6.4	7.0	3.6	5.2	LCM SI67
1968	6.6	6.1	7.2	7.2	5.7	5.3	9.5	4.5	5.8	5.6	6.5	7.2	6.4	LCM SI68
1969	6.5	7.4	8.0	5.0	6.0	2.6	3.5	4.8	4.5	5.2	6.7	7.1	5.6	LCM SI69
1970	7.5	0.0	7.2	7.0	7.7	4.1	4.8	4.5	4.8	3.2	7.6	7.1	6.0	LCM SI70
1971	7.3	6.0	6.0	6.0	4.7	7.0	3.2	4.9	4.7	4.7	3.4	6.2	5.3	LCM SI71
1972	6.7	3.5	6.3	4.7	5.3	2.8	2.8	3.7	3.2	0.0	5.0	6.2	4.6	LCM SI72
1973	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	LCBSSI73
1974	3.0	1.5	2.0	0.0	0.0	0.0	4.5	4.2	2.5	0.0	6.7	5.7	3.8	LCWPSI74
1975	4.7	3.7	6.2	4.1	5.2	2.1	3.3	7.5	6.5	6.0	6.7	7.4	5.3	LCWPSI75
1976	7.4	0.0	6.3	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	LCWPSI76
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AVERAGE	7.0	6.3	6.6	6.4	6.0	4.8	4.7	5.4	5.0	6.4	6.5	6.6	6.0	

COLIF MPN/100 LITTLE COTTNWD AT PERUVIAN- SLCWD 4/ 6/71-4/76 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1971	0.0	0.0	0.0	0.0	0.0	0.0	33.0	41.0	22.0	53.0	159.0	240.0	91.3	LCPL C71
1972	0.0	0.0	0.0	0.0	33.0	75.0	19.0	37.0	61.0	267.0	3167.0	188.0	480.9	LCPL C72
1973	35.0	52.0	14.0	26.0	35.0	32.0	25.0	46.0	49.0	15.0	12.0	57.0	33.2	LCPL C73
1974	6.8	41.8	27.3	114.0	54.0	15.3	25.6	38.0	16.8	34.0	35.7	51.7	38.4	LCPL C74
1975	24.8	23.7	34.0	45.3	19.0	26.8	55.3	54.0	45.5	7.3	15.5	0.7	29.3	LCPL C75
1976	10.8	13.0	9.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.8	LCPL C76
AVERAGE	19.4	32.6	21.1	48.0	35.2	37.3	31.6	43.2	38.9	75.3	677.8	107.5	104.5	

COLIF MPN/100 LITTLE COTTNWD BELOW SNOBRD-SLCWD 4/ 6/71-4/76 ANAL: CCHD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1971	0.0	0.0	0.0	0.0	0.0	0.0	5.0	10.0	61.0	19.0	33.0	33.0	26.8	LCSB C71
1972	36.0	56.0	77.0	91.0	392.0	22.0	13.0	9.0	25.0	164.0	171.0	149.0	100.4	LCSB C72
1973	19.0	18.0	10.0	15.0	58.0	28.0	24.0	27.0	121.0	33.0	71.0	32.0	38.0	LCSB C73
1974	12.0	14.0	21.7	33.0	50.2	27.5	28.6	30.3	9.0	37.6	31.3	42.0	28.1	LCSB C74
1975	22.8	19.3	40.0	38.0	20.0	38.8	59.3	56.5	40.8	7.5	12.5	1.0	29.7	LC[illegible] C75
1976	4.8	9.3	10.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	LCSB C76
AVERAGE	18.9	23.3	31.8	36.1	130.1	29.1	26.0	26.6	51.4	52.2	63.8	51.4	43.9	

COLIF MPN/100 LITTLE COTTNWD AT SNOBRD/STA2-SBC 4/MO 73-75 ANAL: FORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1973	0.0	0.0	190.0	132.0	110.0	32.0	63.0	71.0	30.0	21.0	27.0	22.0	69.8	LSB2 C73
1974	17.0	27.0	43.0	30.0	48.0	26.0	30.0	26.0	13.0	12.0	6.0	15.0	24.4	LSB2 C74
1975	20.0	17.0	15.0	11.0	22.0	18.0	16.0	17.0	44.3	11.8	14.0	17.3	18.6	LSB2 C75
AVERAGE	18.5	22.0	82.7	57.7	60.0	25.3	36.3	38.0	29.1	14.9	15.7	18.1	35.7	

SS, MGL/100 LITTLE COTTNWD AT SNOBRD/STA2-SBC 4/MO 73-75 ANAL: FORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1973	0.0	0.0	1100.0	472.0	24.7	8.6	7.8	2.1	16.0	3.4	2.9	1.5	163.9	LSB2SS73
1974	1.3	2.2	2.5	2.9	17.7	16.6	2.9	1.6	1.3	2.4	1.3	1.9	4.6	LSB2SS74
1975	5.6	5.4	3.8	4.8	41.5	27.3	11.5	3.6	22.8	6.3	2.1	2.2	11.4	LSB2SS75
AVERAGE	3.5	3.8	368.8	159.9	28.0	17.5	7.4	2.4	13.4	4.0	2.1	1.9	53.8	

BOD, MGL/100 LITTLE COTTNWD AT SNOBRD/STA2-SBC 4/MO 73-75 ANAL: FORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1973	0.0	0.0	4.9	3.9	2.0	2.0	2.6	2.9	2.1	2.2	2.0	2.4	2.7	LL[illegible]B073
1974	2.0	1.8	2.0	3.2	2.3	2.8	1.8	2.2	1.9	2.6	2.3	2.2	2.3	LSB2B074
1975	2.8	2.3	3.0	2.5	3.7	3.4	2.9	2.8	2.4	2.3	2.1	2.3	2.7	LSB2B075
AVERAGE	2.4	2.0	3.3	3.2	2.7	2.7	2.4	2.6	2.1	2.4	2.1	2.3	2.5	

COLIF MPN/100 LITTLE COTTNWD AT SNOBRD/STA6-SBC 4/MO 73-75 ANAL: FORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1973	0.0	0.0	930.0	960.0	246.0	92.0	205.0	158.0	49.0	22.0	228.0	46.0	293.6	LSB6 C73
1974	31.0	56.0	23.0	63.0	187.0	42.0	34.0	73.0	18.0	15.0	15.0	27.0	48.7	LSB6 C74
1975	16.0	18.0	20.0	14.0	31.0	21.0	24.0	21.0	20.0	17.2	22.0	19.5	20.3	LSB6 C75
AVERAGE	23.5	37.0	324.3	345.7	154.7	51.7	87.7	84.0	29.0	18.1	88.3	30.8	110.7	

SS, MGL/100 LITTLE COTTNWD AT SNOBRD/STA6-SBC 4/MO 73-75 ANAL: FORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1973	0.0	0.0	0.0	12.2	20.8	17.4	7.2	2.5	8.2	3.3	2.7	2.6	8.5	LSB6SS73
1974	4.2	2.8	2.3	3.4	15.5	16.7	2.1	1.4	1.4	2.0	7.8	2.6	5.2	LSB6SS74
1975	4.6	2.4	2.2	2.9	45.4	23.5	15.2	4.5	6.4	3.3	3.5	3.1	9.8	LSB6SS75
AVERAGE	4.4	2.6	2.2	6.2	27.2	19.2	8.2	2.8	5.3	2.9	4.7	2.8	7.8	

BOD, MGL/100 LITTLE COTTNWD AT SNOBRD/STA6-SBC 4/MO 73-75 ANAL: FORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG	IDENT
1973	0.0	0.0	5.0	5.4	2.7	2.4	2.7	2.9	2.8	2.9	2.6	2.5	3.2	LSB6B073
1974	2.9	3.0	2.9	2.6	2.9	3.0	2.2	2.4	2.3	2.7	3.0	2.5	2.7	LSB6B074
1975	3.3	3.0	3.5	2.5	4.3	3.1	3.4	3.5	1.9	2.8	2.6	2.8	3.1	LSB6B075
AVERAGE	3.1	3.0	3.8	3.5	3.3	2.8	2.8	2.9	2.3	2.8	2.7	2.6	3.0	

APPENDIX B

LAND USE IN WASATCH CANYONS

LEGEND

(P) - PICNIC SITE

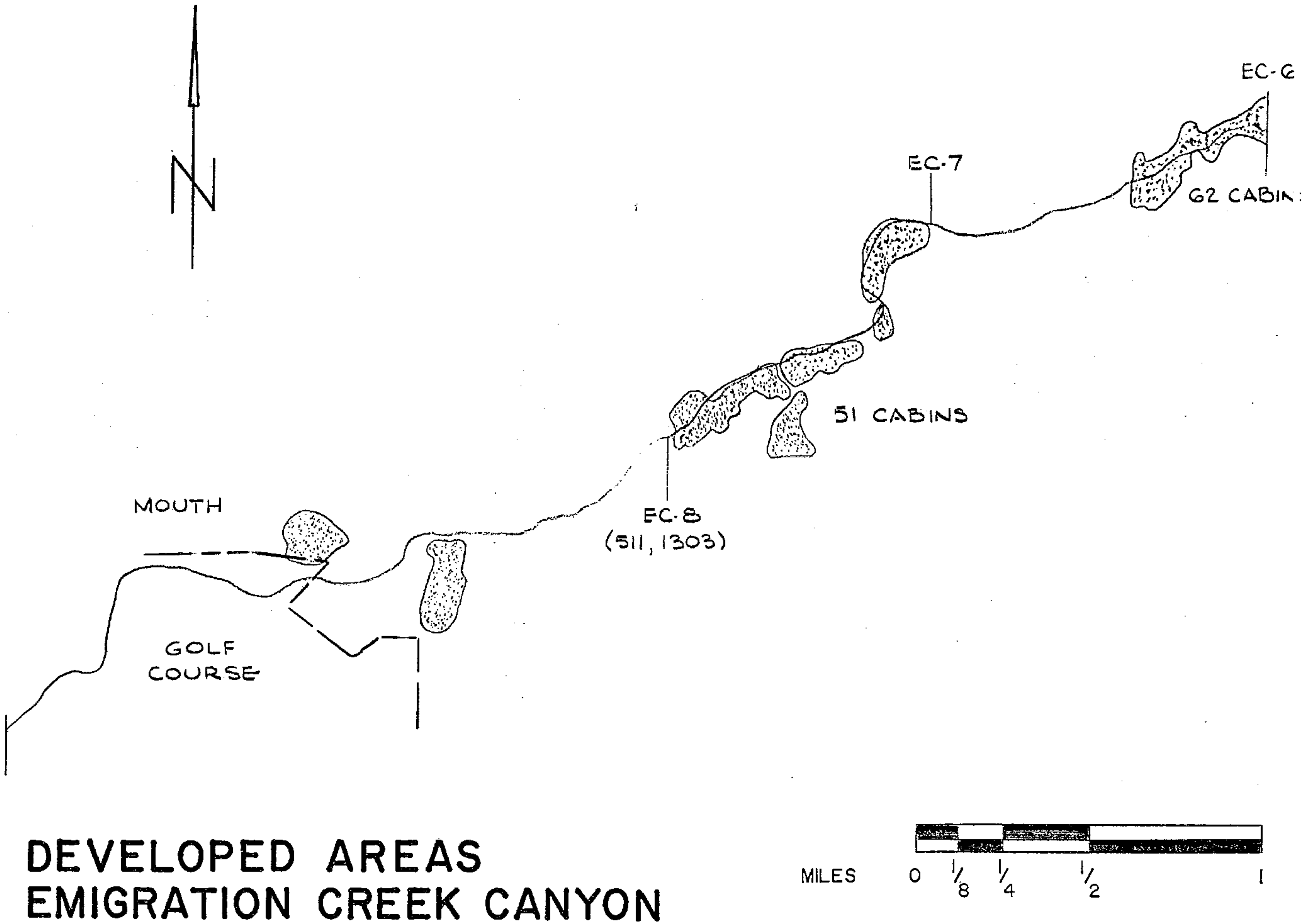
(C) - CAMP SITE

(Co) - COMMERCIAL

(I) - INSTITUTIONAL

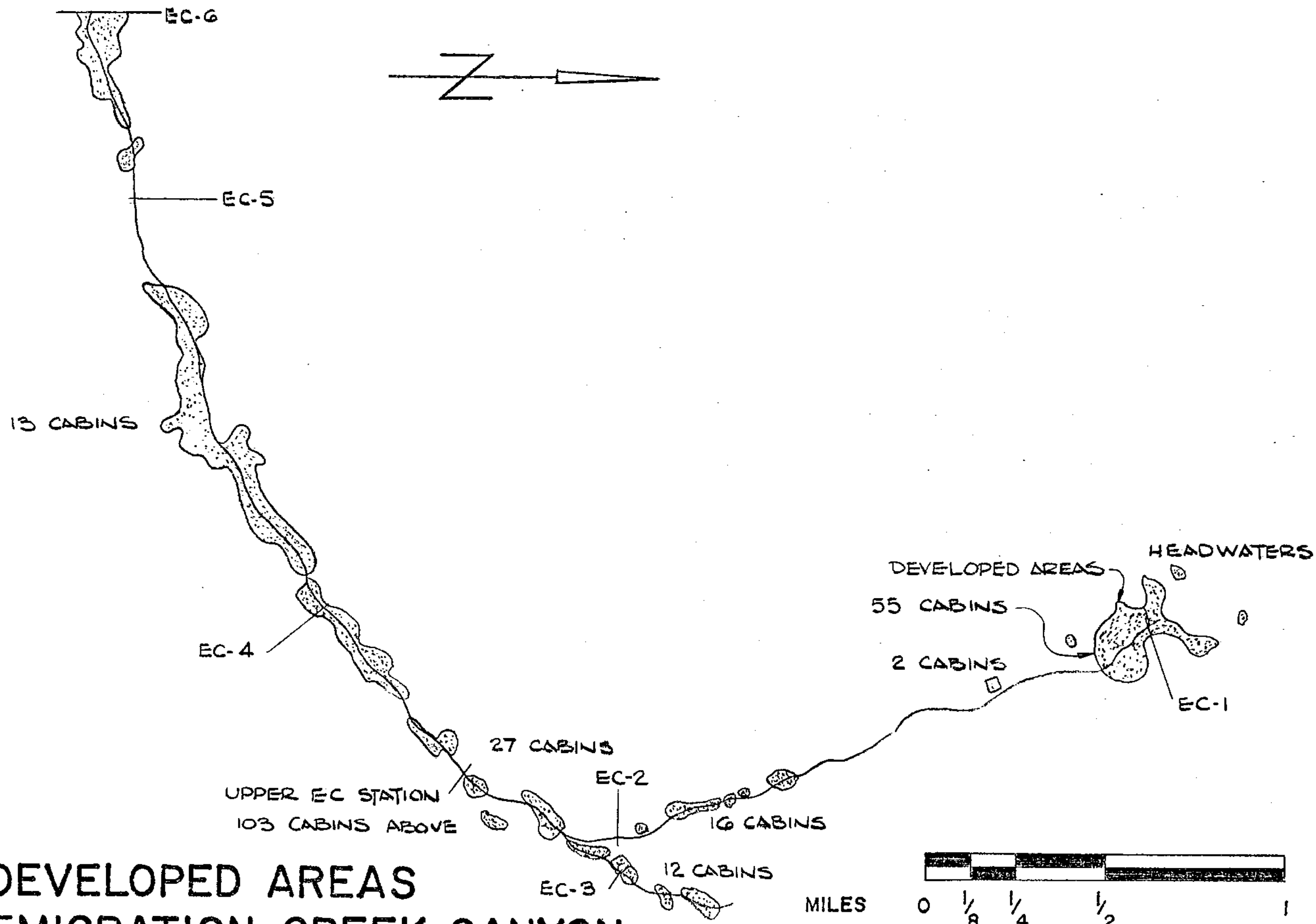

-DEVELOPED AREA: RESIDENTIAL, PARKING OR MISCELLANEOUS

EC
MC
BC
LC
} LOCATION SAMPLE SITE

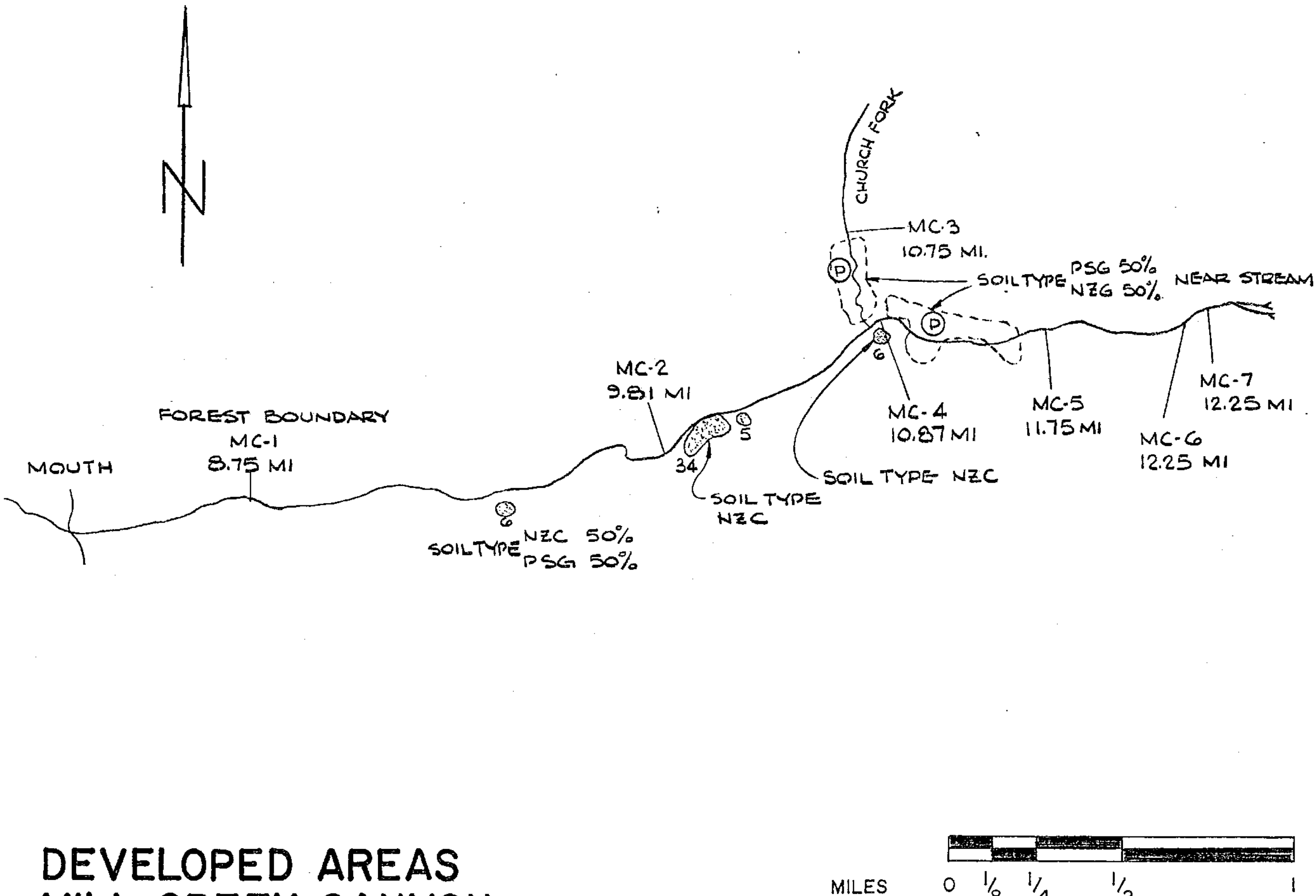


DEVELOPED AREAS EMIGRATION CREEK CANYON

FIGURE B-1

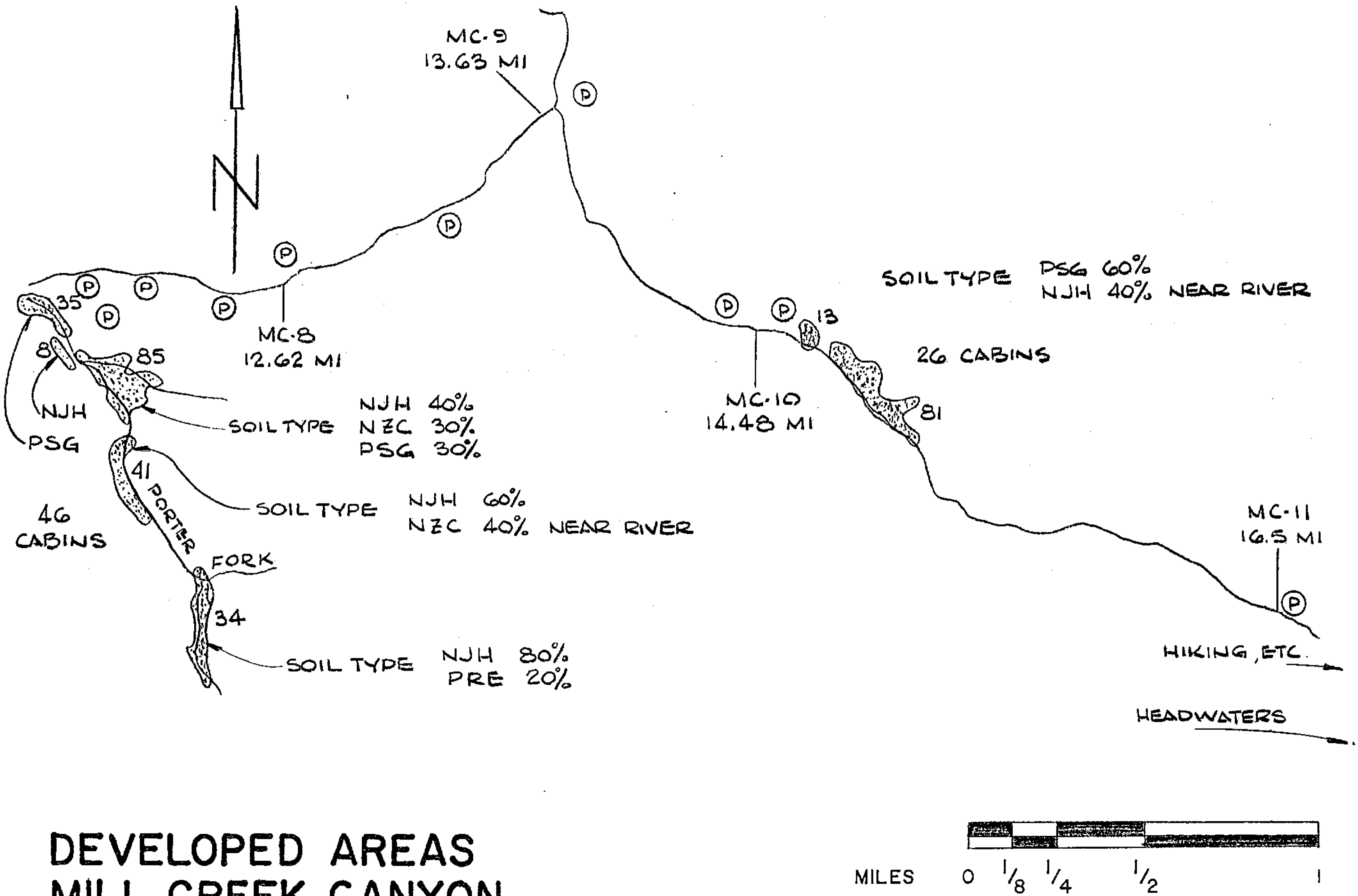


DEVELOPED AREAS
EMIGRATION CREEK CANYON
FIGURE B-2



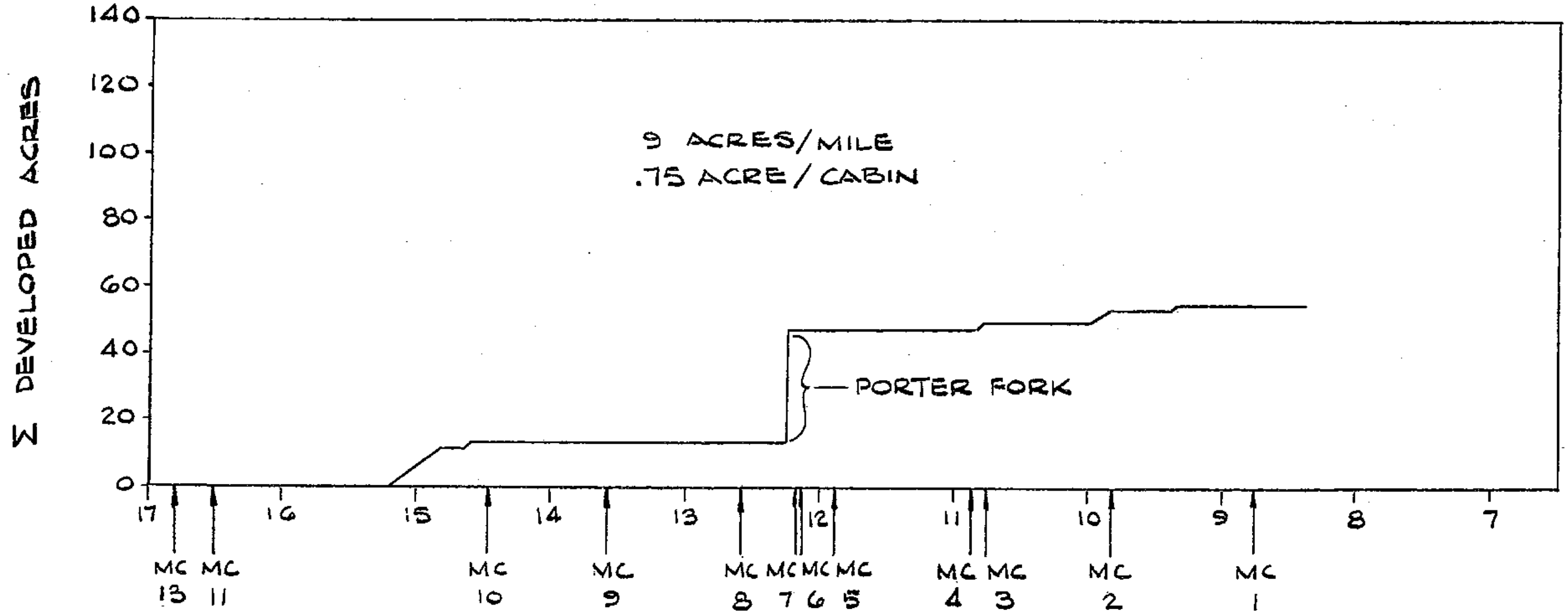
DEVELOPED AREAS MILL CREEK CANYON

FIGURE B-3



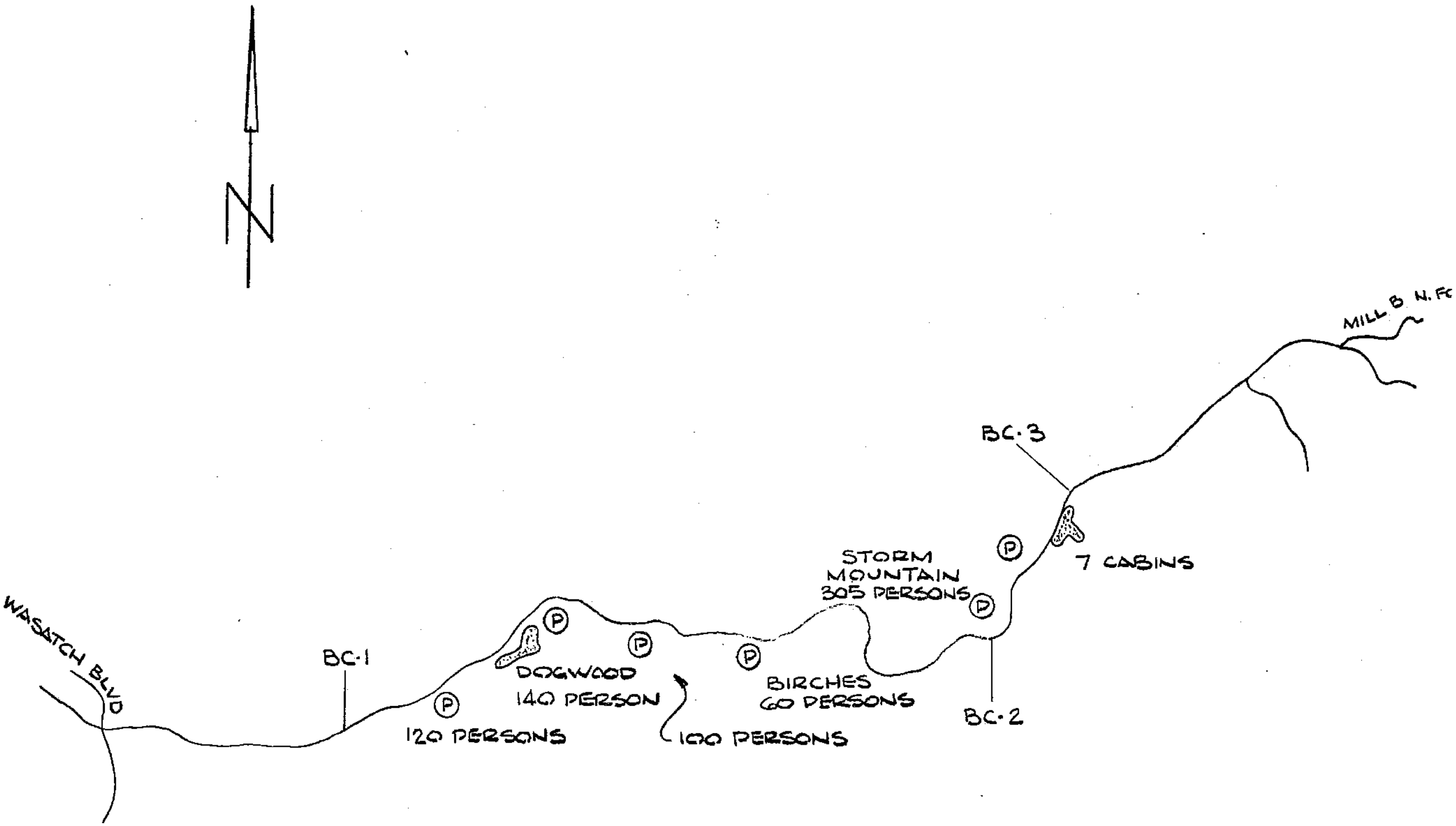
DEVELOPED AREAS
MILL CREEK CANYON

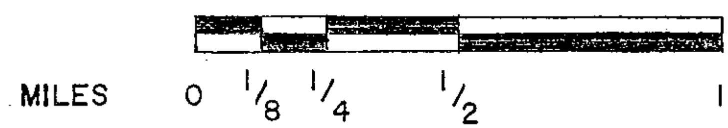
FIGURE B-4



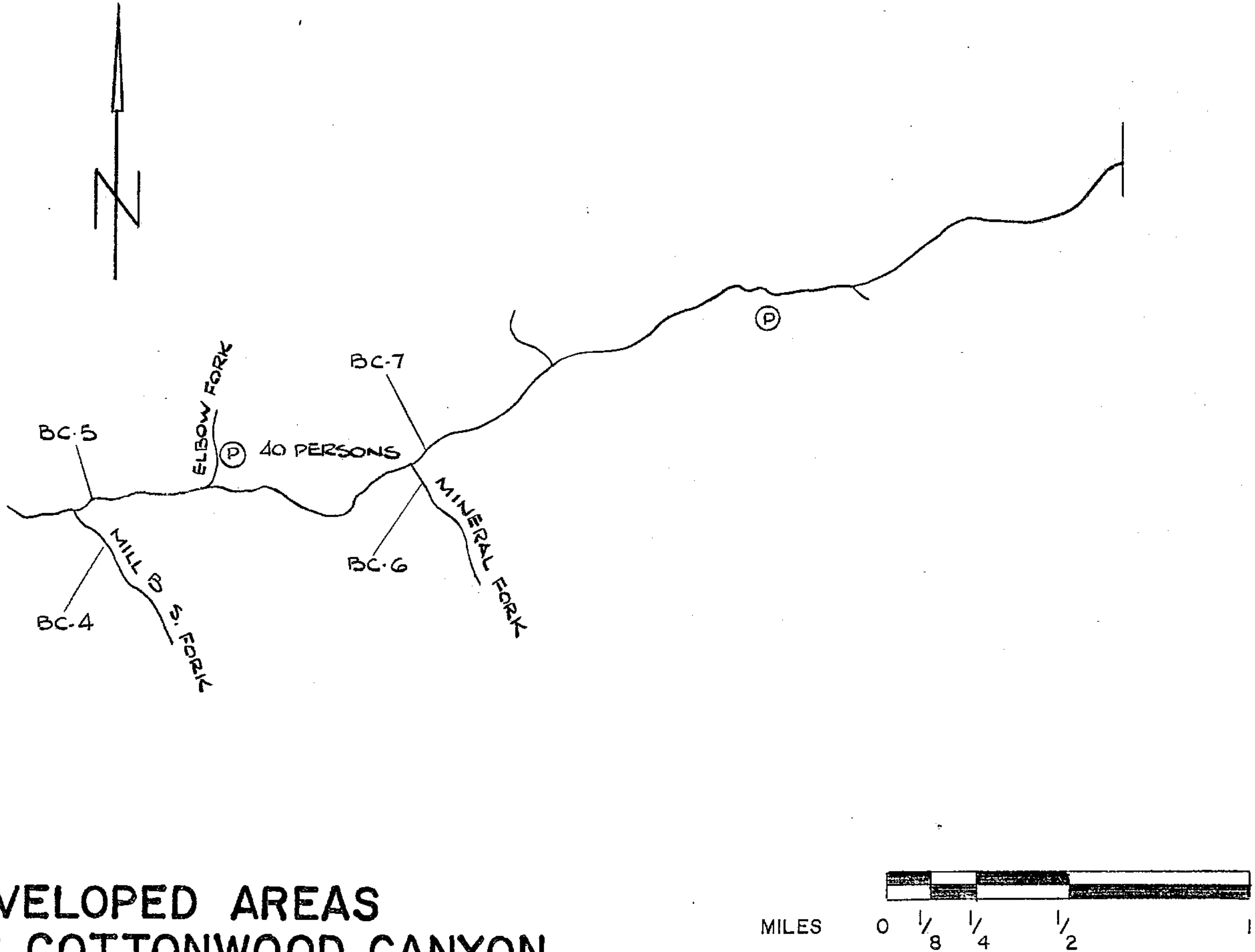
CUMULATIVE DRAINAGE AREA
MILL CREEK CANYON

FIGURE B-5



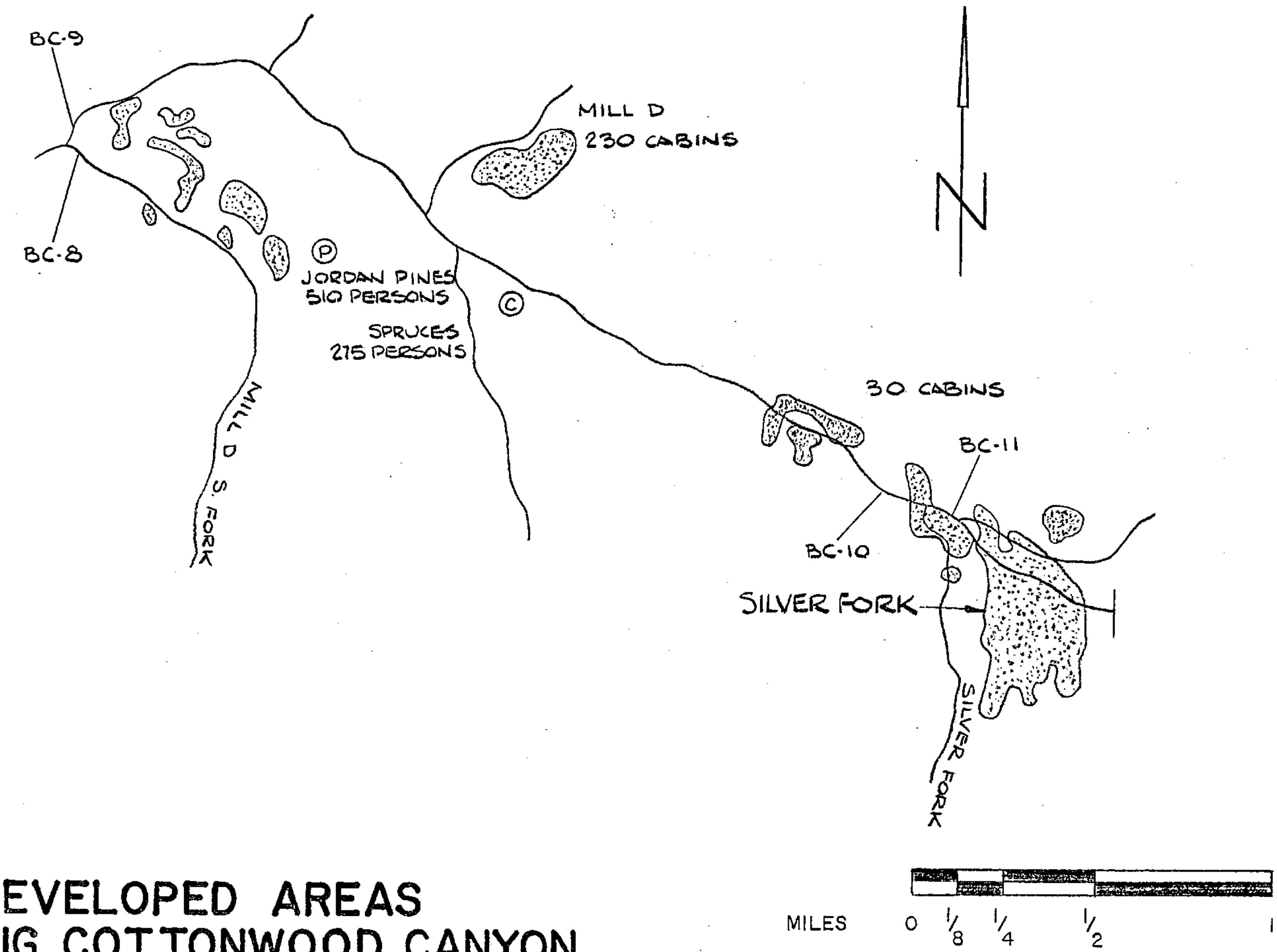


DEVELOPED AREAS
BIG COTTONWOOD CANYON
FIGURE B-6



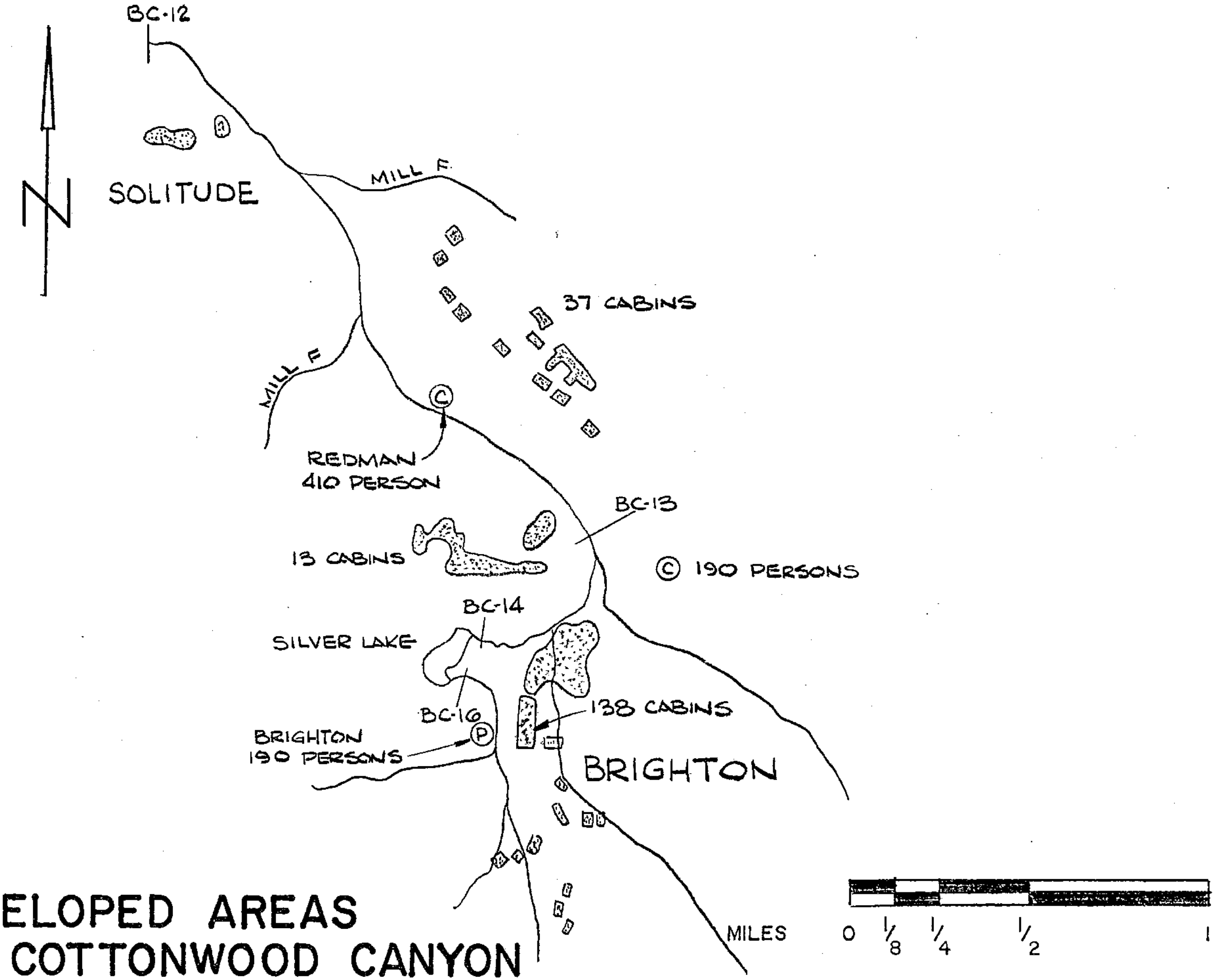
DEVELOPED AREAS
BIG COTTONWOOD CANYON

FIGURE B-7



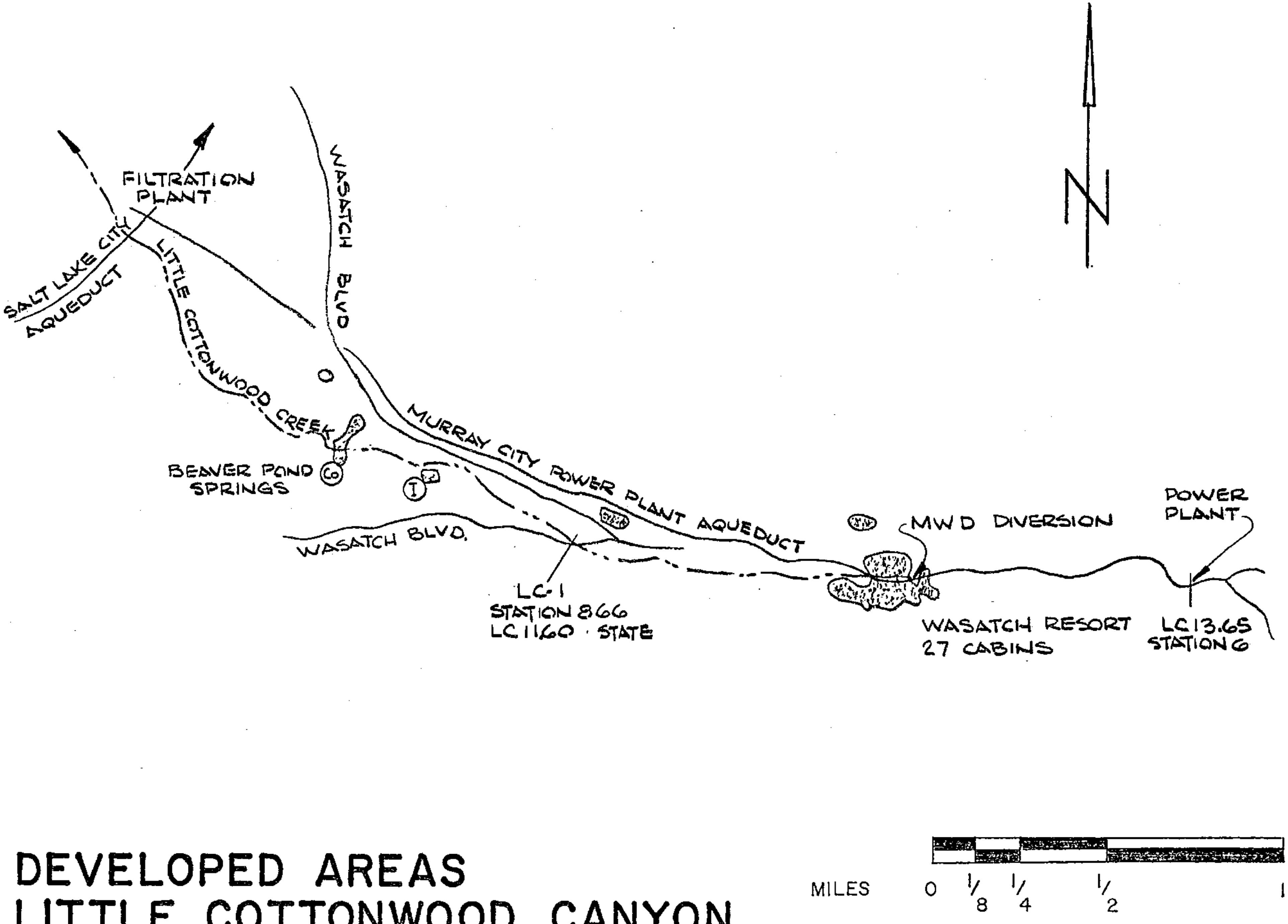
DEVELOPED AREAS
BIG COTTONWOOD CANYON

FIGURE B-8

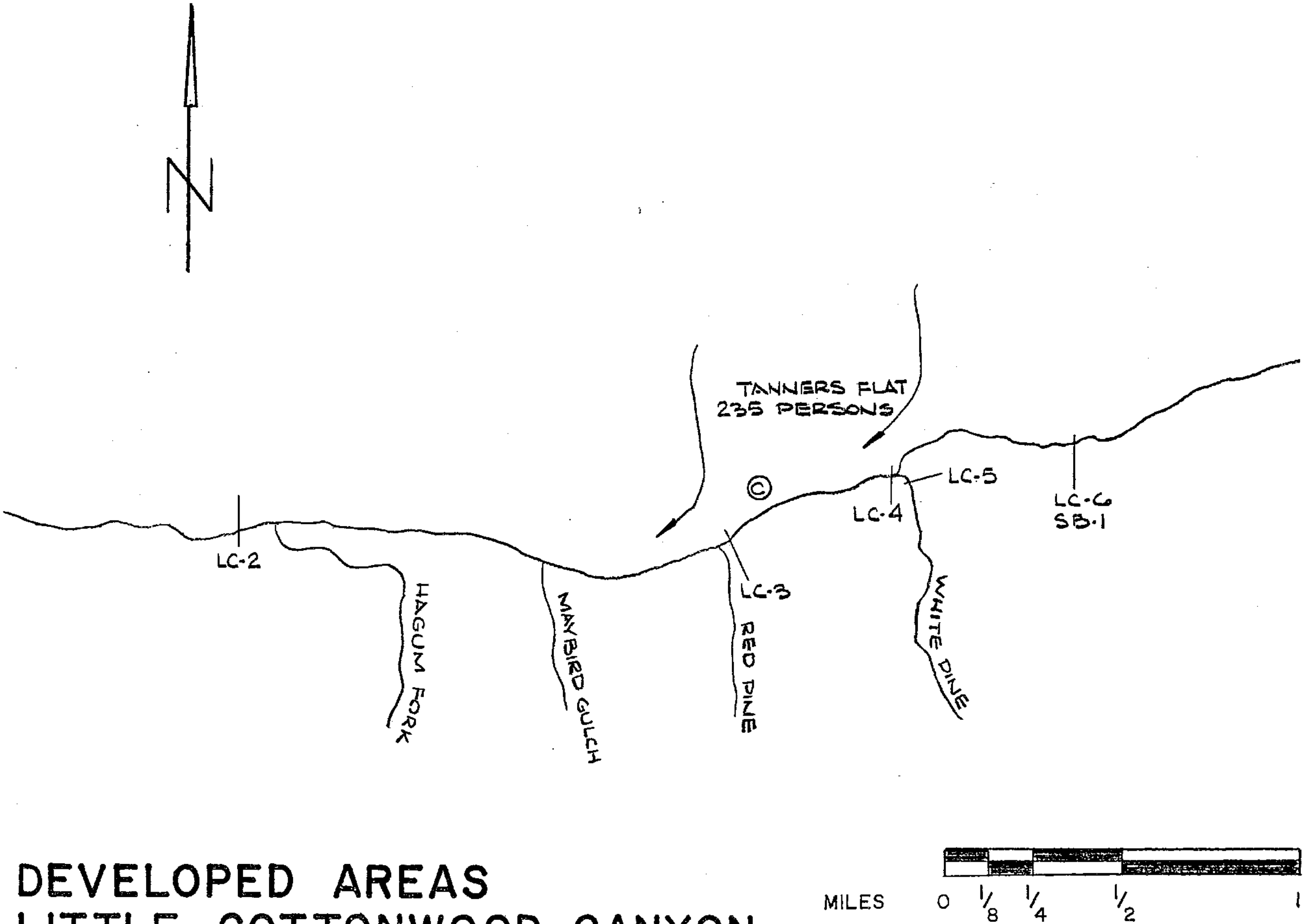


DEVELOPED AREAS
BIG COTTONWOOD CANYON

FIGURE B-9

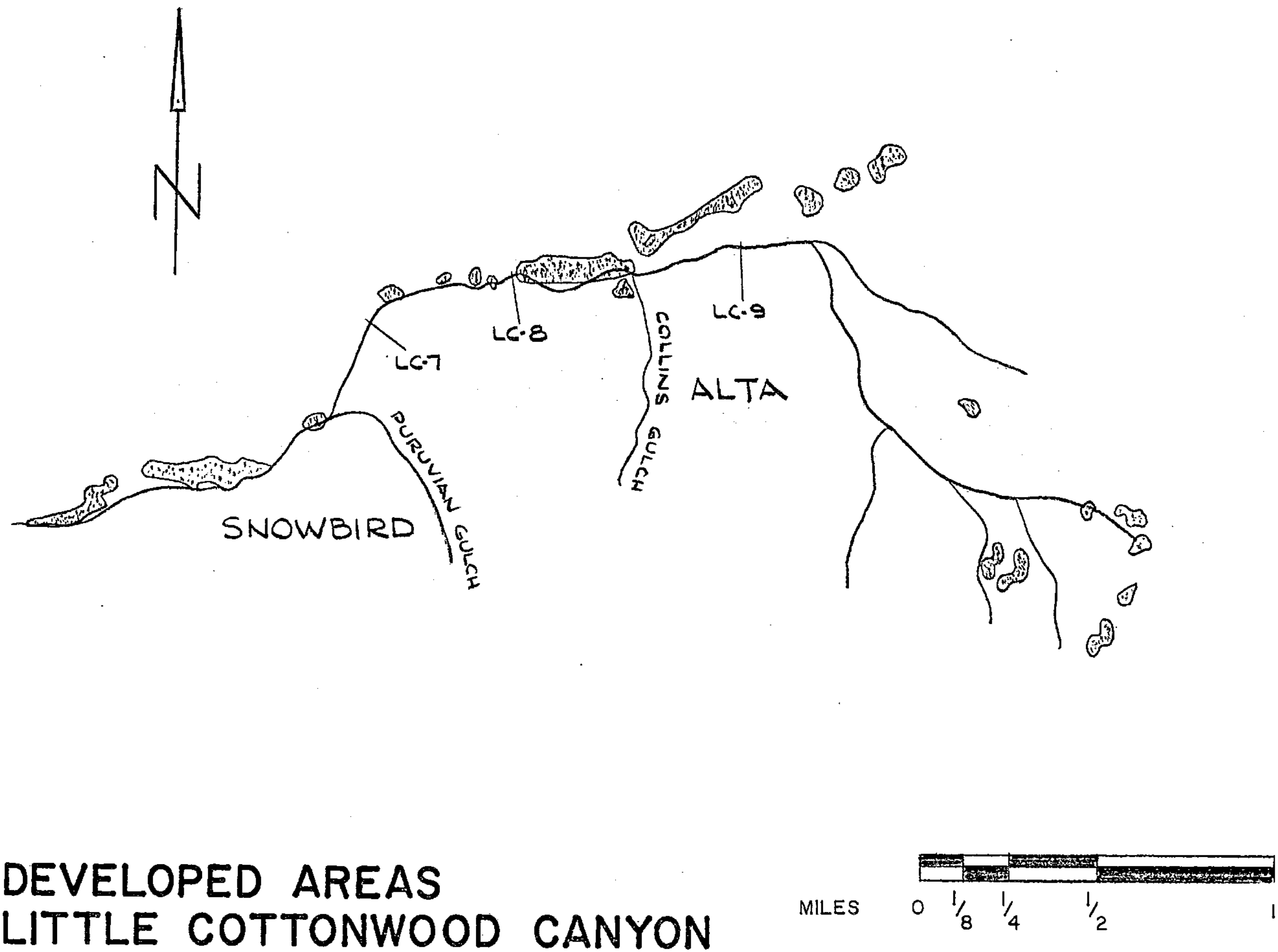


DEVELOPED AREAS
LITTLE COTTONWOOD CANYON
FIGURE B-10



DEVELOPED AREAS
LITTLE COTTONWOOD CANYON

FIGURE B-11



DEVELOPED AREAS
LITTLE COTTONWOOD CANYON
FIGURE B-12