

MONITORING BASELINE GROUND-WATER AND SURFACE-WATER CHARACTERISTICS IN
THE VICINITY OF ZION AND BRYCE CANYON NATIONAL PARKS
AND PIPE SPRING NATIONAL MONUMENT,
SOUTHWESTERN UTAH AND NORTHWESTERN ARIZONA

Project proposal for
studies beginning in 1988

by
Geoffrey Freethey
U.S. Geological Survey

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INTRODUCTION

Southwestern Utah and northwestern Arizona is an area of outstanding scenic beauty, but the area also contains large minable coal deposits. Extracting these coal reserves will require use of water and may cause a significant disturbance of the land where the coal is buried. Bryce Canyon National Park is a few miles north of the Alton coal field and Zion National Park is a few miles south of the Kolob coal field. The hanging gardens in Zion are supported by spring discharge from the Navajo Sandstone. Pipe Spring National Monument, whose source of spring flow is also the Navajo Sandstone, is about 30 to 40 miles south of these coal areas. Water in the Navajo is not used at Bryce Canyon National Park because it is too deep. If mining takes place it will occur in the upper reaches of the Virgin River and the Kanab Creek drainages. Water needed for slurring the coal for transport would probably be pumped from the Navajo Sandstone north of Kanab, Utah.

This project will define selected baseline (premining or pre-other development) characteristics of surface and ground water and their seasonal variability. These characteristics would include the chemical quality of water from springs, the quantity of flow from springs, the discharge and chemical quality of water in streams, and the suspended sediment in streams. If these baseline values and their seasonal variability are recorded for several years, then the general range of values that plants and animals in the parks are accustomed to can be established. This record of baseline values and continued monitoring during any development can then be used to determine if, when, and the extent that coal mining or pumping are affecting the hydrologic environment of Zion, Pipe Spring, or Bryce Canyon.

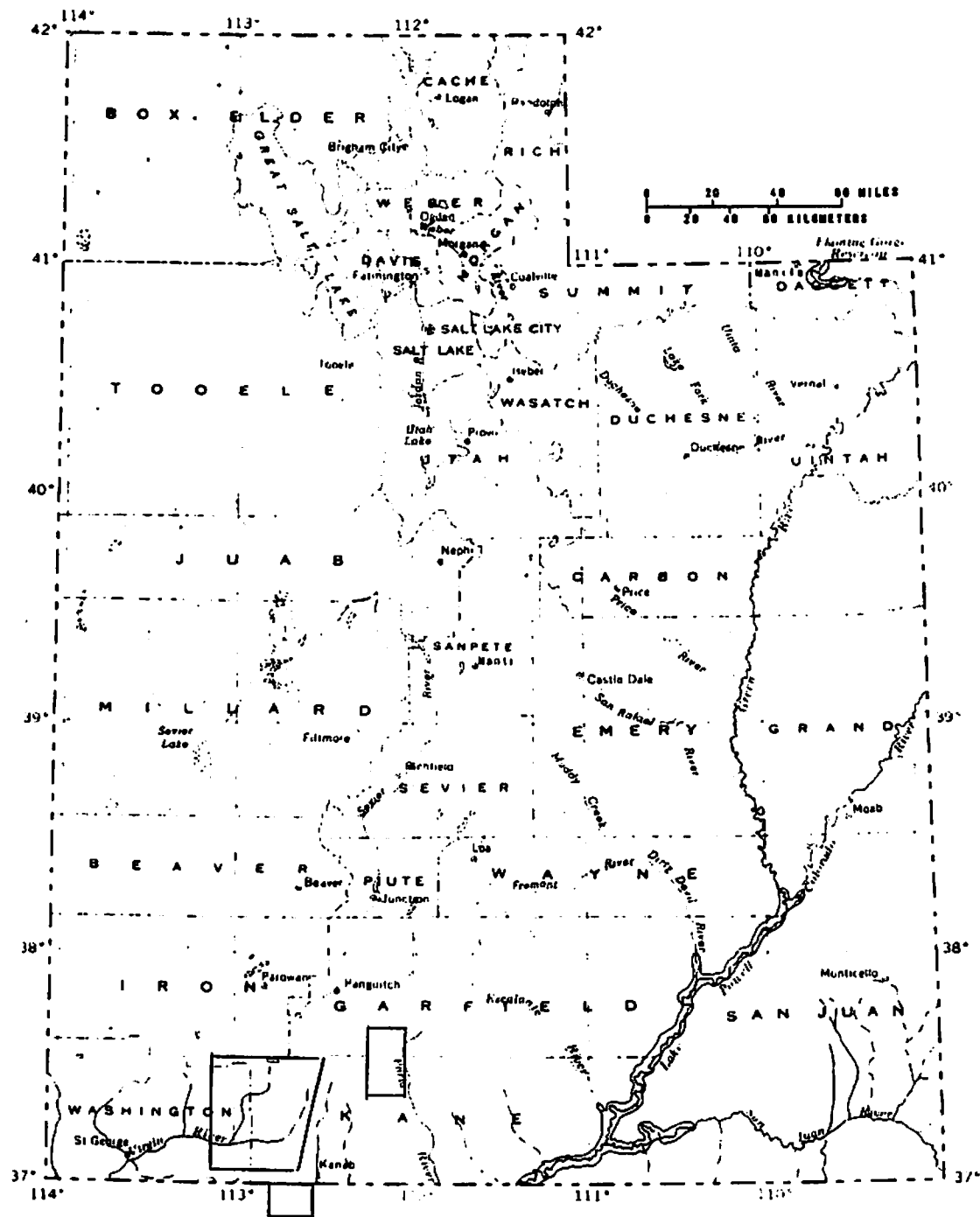


Figure 1.-- Location of study areas

The study area will include the Virgin River drainage upstream from Virgin, Utah, the springs at Pipe Spring National Monument and the area to the north on the Kaibab Indian Reservation, and the upper reach of the East Fork of the Sevier River and springs east and west of Bryce Canyon National Park (fig. 1).

PURPOSE

The objectives of this study are to establish baseline values and their seasonal variability for (1) chemical quality of water from springs, (2) discharge of springs, (3) chemical quality of water in streams of the Virgin and upper East Fork Sevier Rivers, (4) quantity of that streamflow, and (5) suspended sediment load of these streams.

APPROACH

Previous Information

Fifteen springs discharging from the Navajo Sandstone in the Virgin River drainage were sampled for chemical analysis in 1986 and 1987. Water from Weeping Wall in Zion National Park was chemically analyzed in 1954. Quantity of flow was estimated or measured for a few of these springs. Three stream-gaging stations are currently operating on the Virgin River at or above Virgin, Utah. Period of record ranges from 22 years for the station on the East Fork of the Virgin near Glendale to 79 years for the station on the Virgin near Virgin, Utah. Two other stations on the North Fork of the Virgin in Zion National Park were operated until 1984. Period of record for these two stations is 6 and 10 years, and includes daily sediment loads for the station with 6 years of streamflow record. One year of sediment-load record was collected at the station at Virgin, Utah in 1969-70. Chemical, nutrient, and biological analyses are available for only specific short-term periods for most of these stations. One stream-gaging station is operating on the East Fork Sevier River west of Bryce Canyon National Park. Period of record is 26 years of flow data.

A previous study describing the quality of surface water in the Upper Virgin River basin (Sandberg and Sultz, 1985) summarizes most of the previously collected surface-water information for the area. A study of the ground-water resources at Bryce Canyon National Park (Marine, 1963) lists springs discharging from Cretaceous formations in the area. Chemical analyses are available for water from seven of the springs and two of the wells in the area. Streams that carry year-round flow near the park include the Paria River and the East Fork Sevier River. A study has been conducted recently by a contractor to the National Park Service on the water-supply facilities and sources for Bryce Canyon National Park.

An investigation of ground-water occurrence and movement in the Navajo Sandstone in the area just east of Zion National Park for the U.S. Bureau of Land Management ended this year and a report is now in review. This report will describe the results of 3 gain-loss studies on the North Fork of the Virgin River and include water-quality data collected. A study has been conducted recently by a contractor to the National Park Service on the water-supply facilities and sources for Bryce Canyon National Park.

Conceptualization of the Hydrologic System

Ground water from the Navajo Sandstone is thought to contribute to the base flow of the Virgin River and its tributaries. The canyon of the East Fork of the Virgin River traverses about 12 miles and the entire thickness of Navajo Sandstone. Canyons of the North Fork of the Virgin River, Deep Creek, Crystal Creek, Kolob Creek, and other tributaries traverse more than 25 miles of exposed Navajo Sandstone, and springs near stream level exist in the lower 10 miles of the main canyon. Stream gain-loss studies conducted during a previous investigation indicate that ground-water inflow between the mouth of Kolob Creek and Orderville Gulch is from 7,000 to 9,000 acre-feet per year, and that more water enters through springs on the east side than springs on the west side. Ground water entering from the east contained larger concentration of dissolved solids than water entering from the west.

The springs at Pipe Spring National Monument and Moccasin to the north on the Kaibab Indian Reservation also discharge from the Navajo Sandstone; however, these springs are related to the Sevier Fault. The upthrown west block of Navajo Sandstone rests against older poorly permable formations, forcing water in the Navajo to the surface along the fault. Variability in flow quantity and in chemical quality for these springs is unknown.

Springs in the vicinity of Bryce Canyon National Park discharge from the Wasatch Formation west of the park and flow into the East Fork Sevier River. Springs discharge from the Kaiparowits Formation, Waweap Sandstone, and Straight Cliffs Sandstone on the east side of the park below the rim and flow into the Paria River drainage. The recharge area for these springs appears to be the park itself above the rim.

Plan of Study

The plan for accomplishing the objectives is as follows:

- Compile and statistically analyze, where feasible, all existing spring-flow data on quantity and quality.
- Compile and statistically analyze, where feasible, all existing streamflow, surface-water quality, and sediment-load data.
- Conduct a stream gain-loss study on the East Fork of the Virgin River.
- Inventory springs discharging into the canyon of the East Fork Virgin, East Fork Sevier, and Paria Rivers (measure discharge and collect samples for chemical analysis).
- Establish a streamflow recording station on Deep Creek just downstream from the confluence with Crystal Creek (fig. 2). Measure sediment load, flow, and specific conductance for at least 2 years.
- Measure sediment load and chemical quality of water at the streamflow recording station on the East Fork Sevier River upstream from Tropic Reservoir to monitor quantity and quality of runoff and spring water from the Wasatch Formation (fig. 3).
- Re-establish the gaging station on the North Fork of the Virgin River above the Narrows. Measure the same parameters as at the Deep Creek station concurrently.
- Conduct a stream gain-loss study on Deep Creek, Crystal Creek, Kolob Creek, and Orderville Gulch. Inventory springs in each canyon.
- Measure quantity of discharge and collect samples for chemical analysis at Pipe Spring and Moccasin Spring, once in the spring and once in the fall.

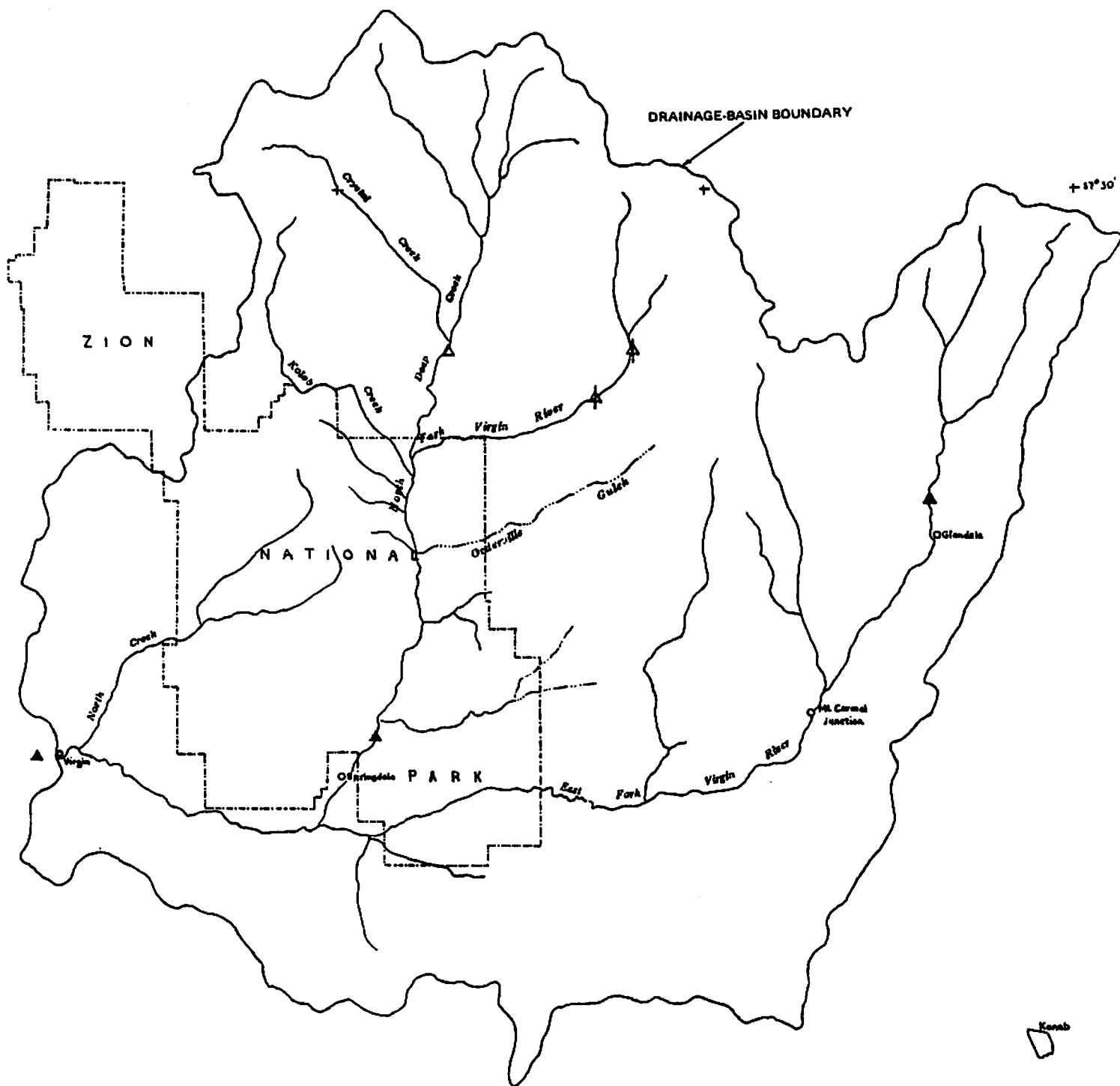


Figure 2.--Zion National Park, Kaibab Indian Reservation, and vicinity.

Determining the above components prior to any upstream development will allow assessment of baseline values and variability of chemical quality and quantity of surface and ground water and sediment load for the Zion and Bryce Canyon Park areas, and of chemical quality and quantity of flow from the springs near Pipe Spring National Monument.

The initial year will involve data compilation, installation of gages, spring inventory, and stream gain/loss studies. Subsequent years will involve only collection of data on a periodic basis and publication of these data in the District's annual data report.

PRODUCTS

It is anticipated that a basic-data report will be produced at the end of the initial year to document baseline hydrologic information, with a very brief text which evaluates the data and their variability. Data from subsequent years would be stored in computer files and published in the District's annual water-resources data reports. All data could be input to a geographic-information-system data base.

MANPOWER AND BUDGET

The project will require a hydrologist, GS-11, part time to coordinate activities and write the final data report. Field activities will be done using periodic assistance from personnel in the Cedar City Subdistrict and other hydrologists as needed for the gain-loss studies and sample collection.

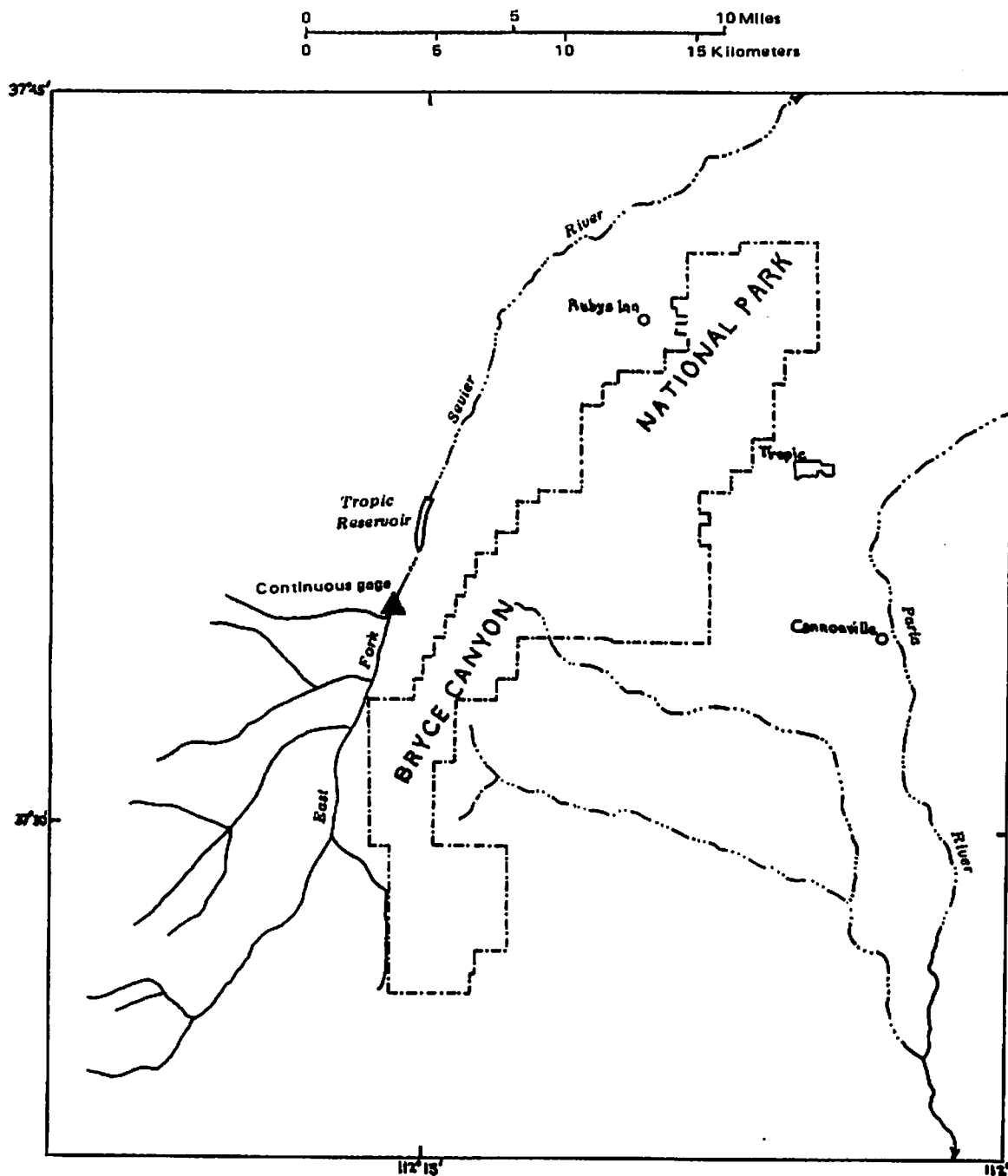


Figure 3.--Bryce Canyon National Park and vicinity.

Estimated costs

Initial year

Install 1 new and 1 previous gage	\$ 18,000
Stream gain-loss studies - 3 wks, Proj. Chief	
2 Field Asst.	5,000
Helicopter to gages and springs	3,000
Chemical analyses of water - about 40 samples	2,800
Field expenses	4,000
Equipment	1,000
Write and publish report	5,200
Support services - Dist. and Hdqtrs	<u>26,500</u>
Total estimate	\$ 65,500

Subsequent years

Service gages and collect samples	12,000
Chemical analyses - 15 samples per year	2,000
Support servives - Dist. and Hdqtrs	<u>9,500</u>
Total per subsequent Year	\$ 23,500

REFERENCES

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