



INTRODUCTION

The development of ground-water supplies in San Juan County included the drilling of wells in many different geologic terrains and land-use settings. The presence of indicator bacteria (coliform and fecal-streptococcus organisms) in water from some wells, however, indicates evidence that the wells have been improperly located or constructed and allow contamination from surface sources to enter the aquifers or wells. The purpose of this sheet is to discuss the concentrations of coliform and fecal-streptococcus bacteria found in water samples from wells tapping the aquifers and to assess the overall sanitary quality of ground water in the islands.

BACTERIA AS PROBABLE INDICATORS OF POLLUTION

Total-coliform, fecal-coliform, and fecal-streptococcus organisms have long been used as indicators of probable pollution from such sources as septic systems and landfills and by runoff from farmlands, animal feedlots, and soils (Greeson and others, 1977). Under proper conditions, the soils, if present and of the proper grain-size distributions, can filter out many bacteria. However, if the well is poorly sealed from the surface or poorly located such that the flow of contaminated water is greater than that which the soil can assimilate, the ground water may not adequately be protected from bacteria. Each of the indicator bacteria types is discussed below.

Total-coliform organisms, although harmless themselves and found naturally in many environments, are almost always present in water that contains pathogens (disease-producing organisms). They are easy to isolate and normally survive longer than pathogenic organisms, and are thus a useful indicator of the possible presence of pathogenic bacteria and viruses. In general, water that is free of total-coliform bacteria is considered free of disease-producing bacteria.

The use of fecal-coliform bacteria to indicate sanitary pollution has proved to be more reliable than the use of total-coliform bacteria because, unlike total-coliform bacteria, fecal bacteria are restricted to the intestinal tract of warm-blooded animals. The occurrence of fecal bacteria in the aquatic environment is generally rare except in areas contaminated by waste water.

In general, fecal-streptococcus bacteria are more resistant to natural and manmade purification processes than are the coliform group. Therefore, streptococci may be the only indicator of fecal pollution at points distant from the source, where fecal coliform is no longer present. When water shows a higher count of fecal streptococci than fecal coliform, it most likely contains wastes of animals, particularly of livestock (Geldreich and Kenner, 1969, p. 337-352). Such conclusions, however, are most reliable when the two bacteria tests are taken close to the source. Otherwise, problems with bacterial die-off obscure meaningful interpretation.

DATA COLLECTION AND ANALYSIS

During August 1981, 171 water-source sites—169 wells and 2 springs—were sampled for the presence of such indicator bacteria as total- and fecal-coliform and fecal-streptococcus bacteria. For purposes of this report, the springs are considered ground-water sites. The locations of all sites are shown on the accompanying map.

Samples from 28 of the 171 sites (16 percent) had total- or fecal-coliform bacteria present. These sites were resampled in September for total- and fecal-coliform bacteria and fecal streptococci to confirm the first sample results.

Water samples were collected in sterilized bottles, placed on ice, and analyzed for the presence of indicator bacteria within 6 hours after collection under the following conditions:

Indicator bacteria	Temperature	Incubation period
Total coliform	35°C	24 hours
Fecal coliform	44.5°C	24 hours
Fecal streptococci	35°C	48 hours

Bacteria tests were carried out by the membrane-filter technique described by Greeson and others (1977). The bacteria colony counts shown on the map are expressed as the number of bacteria colonies present in 100 mL (milliliters) of sample. One or more colonies per 100 mL is a positive test.

INDICATOR BACTERIA IN GROUND WATER

The accompanying map shows all sites with positive bacteria counts on one or both visits that were sampled for indicator bacteria during August and September 1981. Mean, median, minimum, and maximum values for the sampling visits are shown in table 1.

Of the 171 ground-water sites sampled in August 1981, 25 sites had positive counts for total coliform, 7 sites for fecal coliform and 28 for both fecal or total coliforms. Thus, 16 percent of the sites had positive counts. The mean and median values of fecal coliforms were less than one colony per 100 mL.

The wells with water that had shown indicator bacteria in August were resampled in September. Analysis for fecal streptococci was added for further indication of waste-water contamination. Total coliform were present in 18 samples and fecal coliform in only one; however, 21 of the samples were positive for fecal streptococci. Median concentrations of fecal coliforms and fecal streptococci were, respectively, less than one and one count per 100 mL.

About half of the well-water samples with positive counts of total coliforms and fecal streptococci were from Orcas Islands; Lopez, San Juan, and Shaw Islands, respectively, had fewer positive samples.

TABLE 1.--Statistical summary of coliform-bacteria concentrations in wells and springs

[All bacteria are expressed in colonies per 100 mL]

Bacteria statistic	August 1981		September 1981	
	Fecal coliform (168 sites)*	Total coliform (164 sites)*	Fecal coliform (30 sites)	Fecal streptococci (30 sites)
Minimum	<1	<1	<1	<1
Maximum	TNTC**	TNTC**	340	2,300
Median	<1	<1	8	<1
Mean	<1	2	12	83
One or more colonies per 100 mL detected	7	25	1	21

*Non-agreement of number of sites shown and actual number sampled results from data discarded for analytical reasons.

Note: The <1 (less-than-one) count reported here and on the adjacent map indicates that no bacteria were found. However, it cannot be assumed that a well is totally free of bacteria when only 100 mL of water is sampled. Therefore, the results are reported as if there had been one bacteria colony on the filter per 100 mL of sample, and the count is preceded by a "less-than" (<) symbol.

**TNTC indicates that bacteria were present in concentrations too numerous to count.

EXPLANATION

- Bedrock well
- Glacial drift well
- Aquifer geology unknown
- Spring
- E1 Well number (see Sheet 1 for explanation of well-numbering system)

Tables:

DOM	Domestic water use	T	Total coliform bacteria
REC	Recreation water use	F	Fecal coliform bacteria
IRR	Irrigation water use	S	Fecal streptococcus bacteria
PS(30)	Public supply showing number (30) of hookups	<1	No bacteria present (see Table 1 for further explanation)
*	Bacteria counts exceeded 4 organisms per 100 milliliters in August and September	TNTC	Too numerous to count
Aug/Sept	Sampling months	-	Well not analyzed for bacteria types in August

OCCURRENCE, QUALITY, AND USE OF GROUND WATER IN ORCAS, SAN JUAN, LOPEZ, AND SHAW ISLANDS, SAN JUAN COUNTY, WASHINGTON

Occurrence of Indicator Bacteria in Ground Water

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