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TOTAL COLIFORM TRENDS IN THE RAW INTAKE OF THE CITY OF HAMILTON WATER WORKS

A. S. Fraser

September, 1975

UNPUBLISHED REPORT
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ARD-75-033

TOTAL COLIFORM TRENDS IN THE RAW INTAKE OF THE CITY OF HAMILTON WATER WORKS

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This report is the result of a study into the long term trends in the total coliform content in the raw intake of the City of Hamilton Water Works facility. The study was undertaken in response to a request by Dr. G.K. Rodgers, A/Chief, Applied Research Division, CCIW.

The available data base was well documented through a series of annual reports by the Hamilton Municipal Laboratories (1956-1971). Data for the years 1972 and 1973 were obtained from unpublished data of the Hamilton Municipal Laboratory. These data are summarized in Table 1.

Examination of the data (see Figure 1) shows a general increasing trend in the total coliform concentration with time. The data set was submitted to a linear regression analysis for closest fit which yielded a positive slope of +2.47 counts 100 mls^{-1} $year^{-1}$. It should be noted, however, that the pre 1953 data is far less variable than the more recent data and if analysed independently exhibits a slope of +0.35 counts 100 mls^{-1} $year^{-1}$. Since the variability increases with time the data set is presented again under a $\log_{10}$ transform (see Figure 2). This representation displays more clearly the increasing trend in total coliform concentrations from 1940-1965. The trend line in Figure 2 was calculated as the best fit cubic regression line of the $\log_{10}$ transformed data set. From this regression curve it appears that from 1966 on, there has been a general decrease in the total coliform count in the raw intake water. This data is quite variable however, with the 1972 and 1973 annual mean concentrations exhibiting values above the trend line. Before it would be

possible to substantiate the downward trend in this parameter further data will be required (1974 and 1975 annual means).

The objectives and standards for raw water sources to be utilized for drinking supplies issued by the Department of National Health and Welfare (1968) and the Department of the Environment, Ottawa (1972) state the acceptable limit to be as follows:

> "At least 90% of the samples in any consecutive 30-day period should have a total coliform density of less than 1,000 per 100 ml (MPN or MFC)".

These agencies also state the objective for waters intended for the purpose of drinking water supply. The objective is stated below.

> "At least 95% of the samples in any consecutive 30-day period should have a total coliform density of less than 100 per 100 ml - (MPN or MFC)".

The criteria used by the IJC with respect to microbiology is stated in the 1972 Great Lakes Water Quality Agreement as:

> "The geometric mean of not less than five samples taken over not more than a 30-day period should not exceed 1,000/100 ml total coliforms, nor 200/100 ml fecal coliforms ...".

The IJC criteria stated above is similar to the Department of the Environment standard but is more explicit in the specification of the minimum sample acquisition requirements and the computational methods procedure.

A normal distribution of the data set yielded a mode of 39.2 counts/100 mls indicating that the most frequent monthly average value was well within the stated objective for drinking water supplies as given by the Department of the Environment. This analysis was carried out for the purpose of establishing trends and has concentrated, thus far, on annual averages. It should be noted, however, that annual averages can be somewhat misleading and in this case tend to obscure certain other facts. For each 30-day period as well as the reporting of the monthly mean figure, the maximum value observed for the month was also reported. The months September - December in general have the highest total coliform counts with maximums at times of 3000 counts/100 mls. The highest reported monthly maximum was 7800 counts/100 mls in July, 1970. The average for this month was 295 counts/100 mls with 29.0% of the samples exceeding the objective level of 100 counts/100 mls. The monthly significance of such high coliform counts is dependent upon the frequency of their occurrance. At this time, this data is not available but will be provided by the Regional Laboratory for Hamilton-Wentworth. It is important to note, however, that the total coliform count in the drinking water intake is, at present, meeting the requirements of the DOE criteria.

It has been suggested that a possible cause of higher and more variable coliform counts in the Hamilton intake waters is due to the movement of the intake pipe. At present the system consists of three intake pipes: a 48" pipe constructed in 1912, a 60" pipe constructed in 1927, and a 96" pipe constructed in 1966. The 48" pipe is not utilized at present (Matheson, personal communication). The two larger pipes are constructed almost parallel to one another with the intake structures approximately 300 ft. apart. Thus, it appears that the intake pipe configuration is not the cause of the increased coliform counts. If the cause of the contamination is desired, a study should be initiated in the surrounding area to identify sources and transport mechanisms as well as hydrologic and climatic influences.

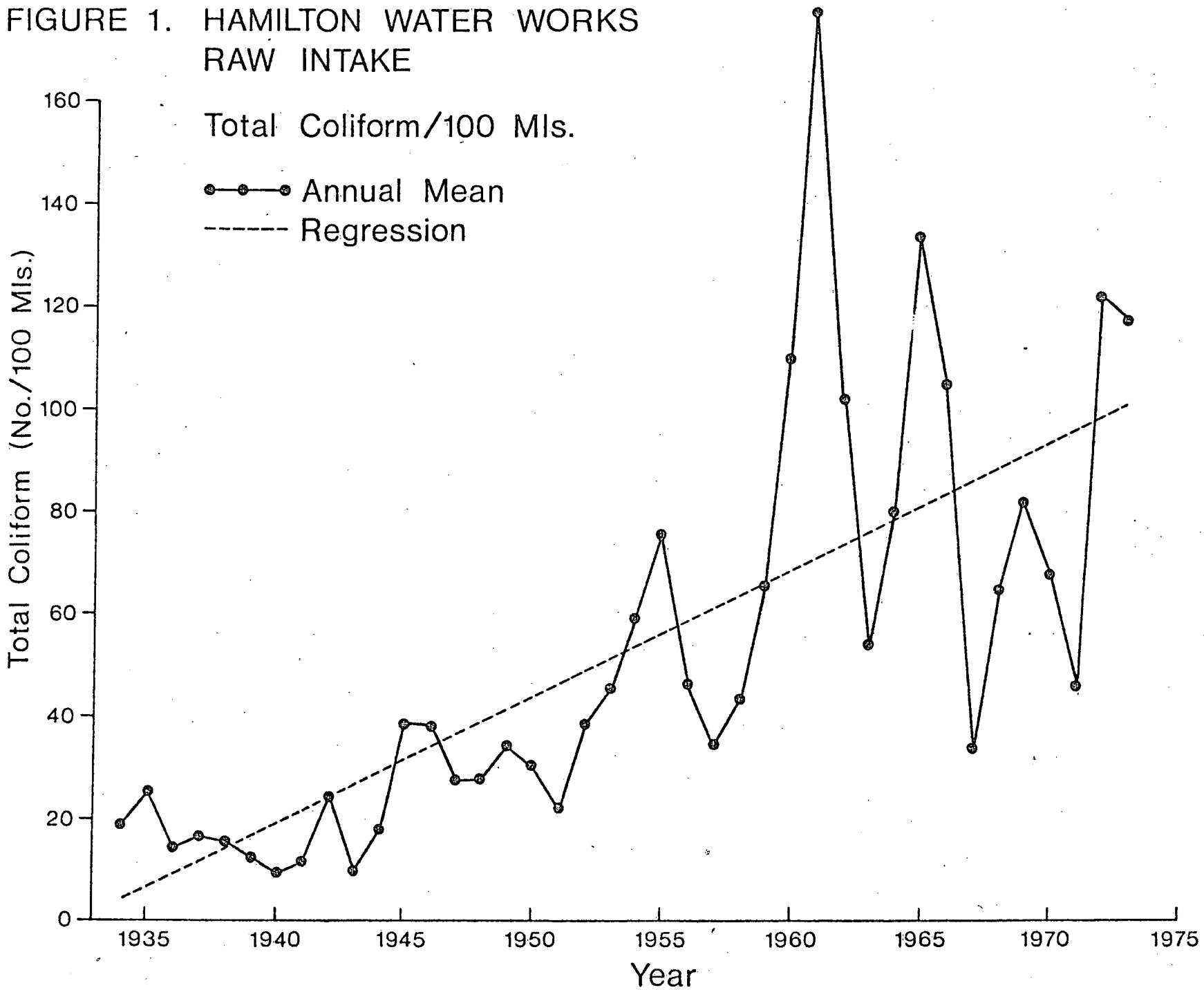
It should be further noted that the data provided by the Hamilton Municipal Laboratory was calculated as the monthly arithmetic mean and therefore a full comparison with the IJC objective, which is couched in terms of the geometric mean, was not possible. In order to make a full comparison it would be necessary to return to the raw analytical data and recalculate.

TABLE 1

Total Coliform / 100 MLS

Year	Mean	Year	Mean
1934	19.5	1954	59.8
1935	25.7	1955	75.7
1936	14.6	1956	46.5
1937	16.8	1957	34.4
1938	15.8	1958	43.3
1939	12.5	1959	65.4
1940	9.9	1960	110.0
1941	11.6	1961	177.0
1942	24.5	1962	102
1943	10.0	1963	54.1
1944	18.0	1964	80
1945	39.2	1965	134
1946	38.3	1966	105
1947	27.3	1967	34
1948	27.8	1968	65
1949	34.8	1969	82
1950	31.0	1970	68
1951	22.1	1971	46
1952	38.5	1972	122
1953	45.8	1973	116

FIGURE 1. HAMILTON WATER WORKS RAW INTAKE



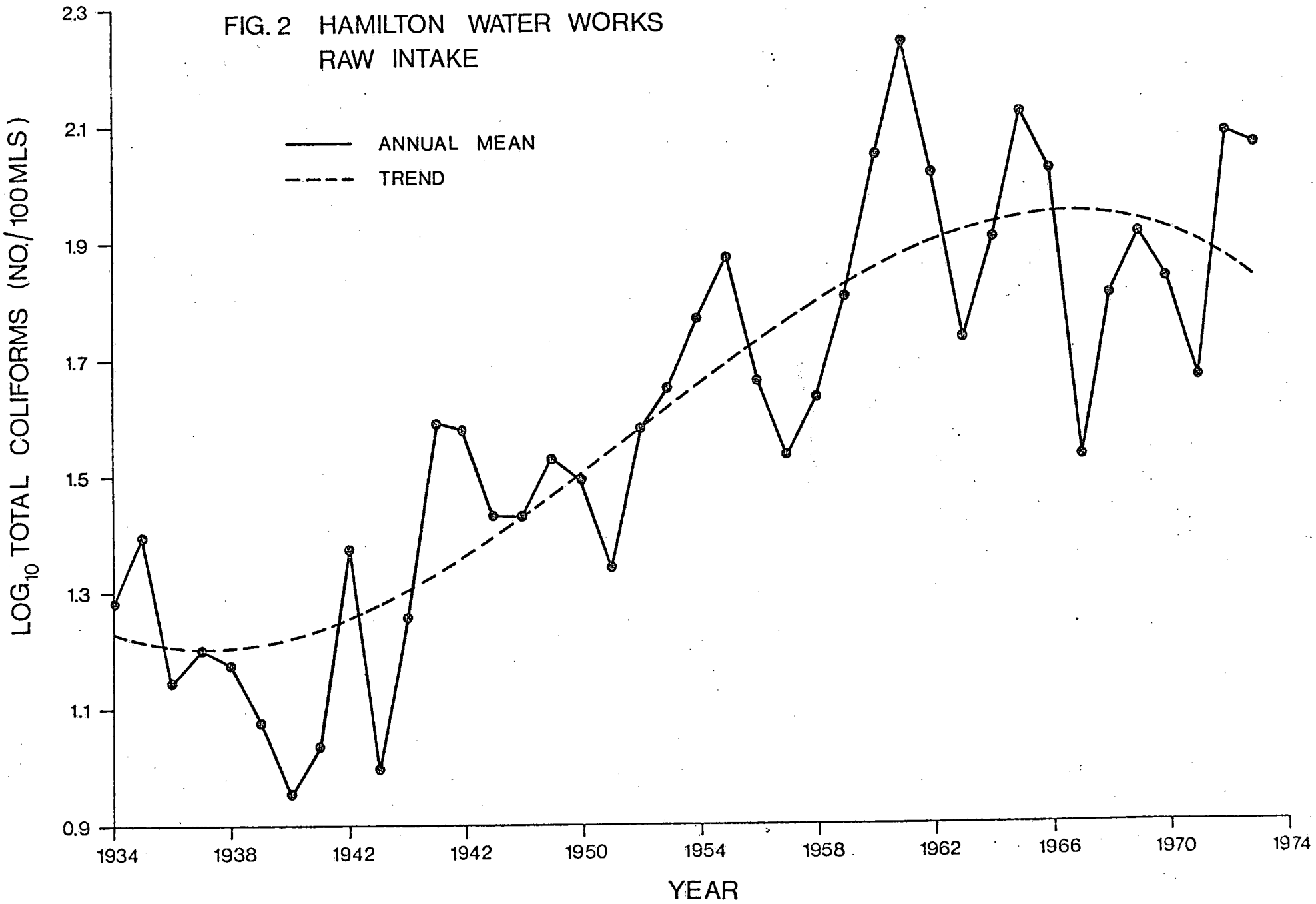


FIG. 2 HAMILTON WATER WORKS
RAW INTAKE
ANNUAL MEAN
TREND
LOG10 TOTAL COLIFORMS (NO./100MLS)
2.3
2.1
1.9
1.7
1.5
1.3
1.1
0.9
1934
1938
1942
1942
1950
1954
1958
1962
1966
1970
1974
YEAR

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