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INTERACTIONS OF EFFLUENTS WITH A RIVER SYSTEM

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ABSTRACT

The lower Oroua River, Manawatu, was studied during the 1977-1978 summer and 1978 autumn to determine what effect two waste discharges had on the quality of the river.

The two discharges were both organic in nature, one being effluent from Thomas Borthwick & Sons (Feilding) meatworks and the other was the effluent from the Feilding Borough Council sewage treatment plant. Both wastes had been biologically treated, Borthwick's wastes by ponding and the Feilding domestic sewage by trickling filtration.

Chemical, microbiological and biological parameters were considered with respect to the effect that the effluents had on the river. The chemical parameters studied were dissolved oxygen, pH, BOD, COD, suspended solids, total kjeldahl nitrogen, nitrate, total phosphorus and orthophosphate. Broad microbiological groups of proteolytic, lipolytic and saccharolytic bacteria were used to quantify the microbiological effects while a brief study was also made on the presumptive and faecal coliforms. The macro-invertebrates and benthic algae were the biological factors studied.

The results showed the Borthwick's effluent to be of very high quality and having minimal effect on the Oroua River. In comparison, the Feilding domestic sewage was of poor quality and it appeared that the trickling filter was seriously overloaded. Consequently this discharge had a pronounced effect on the Oroua River. Most of the chemical parameters were affected by this discharge as were the microbiological densities. The growth of algae did not appear to be influenced by any nutrient input by the discharges.

During daylight hours the high amount of algal photosynthesis more than compensated for the oxygen demand from degradation of organic matter below the Feilding domestic sewage and supersaturated dissolved oxygen levels were recorded. However, at night the combination of this oxygen demand and that of algal respiration resulted in severe oxygen deficits.

The structure of the macroinvertebrate communities in the Oroua River upstream of the 2 discharges had changed imperceptibly since 1956 (Pol. Adv. Council, 1957). The macroinvertebrate community structure below the Borthwick's meatworks discharge indicated that the river quality had improved substantially since 1956 while the community below the sewage discharge showed that the river recovered in a shorter flow distance. The chemical results were found to corroborate the macroinvertebrate results.

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B.O.D.	Biochemical oxygen demand (g/m^3)
BI	Biotic index (Trent)
b (subscripted)	Benthal conditions
C	Dissolved oxygen concentration (g/m^3)
C_c	Critical dissolved oxygen concentration (g/m^3)
C_0	Saturation dissolved oxygen concentration (g/m^3)
C.O.D.	Chemical oxygen demand (g/m^3)
D.O.	Dissolved oxygen (g/m^3)
H	Stream depth (m)
IDI	Diversity index based on information theory
K	Reaeration constant (g/m^3/unit time)
K'	Average reaeration constant (g/m^2/unit time)
K_1	Deoxygenation coefficient ($time^{-1}$)
K_a	Deoxygenation coefficient in benthal sediments ($time^{-1}$)
K_b	Bacterial death rate coefficient ($time^{-1}$)
K_{COD}	Decline rate constant for C.O.D. ($time^{-1}$)
K_{KN}	Decline rate constant for kjeldahl nitrogen ($time^{-1}$)
L	B.O.D. concentration (g/m^3)
LDI	Diversity index based on logarithmic series
L_0	Initial B.O.D. concentration (g/m^3)
N	Bacterial density (no/100 ml)
N	Number of macroinvertebrates
N_i	Number of macroinvertebrates in ith specie
N_0	Initial bacterial density (no/100 ml)
P	Productivity (or photosynthesis) (g/m^3/unit time)
P'	Average productivity (or photosynthesis) (g/m^3/unit time)
p	Period of day
P_m	Peak productivity rate (g/m^2/unit time)
Q_e	Rate of change in D.O. at dusk (g/m^3/unit time)
Q_m	Rate of change in D.O. at dawn (g/m^3/unit time)
R	Respiration (g/m^3/unit time)
R'	Average respiration (g/m^2/unit time)
R	Redundancy (biotic results)
S	Number of macroinvertebrate species
SCI	Sequential comparison index
S_e	Percent D.O. saturation at dusk
S_m	Percent D.O. saturation at dawn

t	time (hours or days)
T	Temperature ^{o}C
$\overline{T}$	Average annual temperature ^{o}C
t_1	Time for start of photosynthesis
t_c	Critical time in D.O. sag curve
V	Velocity m/s
w/v	Weight/volume
Y	Daily oxygen demand at a point in a river (g/m^3/day)
Y'	Average daily oxygen demand at a point in a river (g/m^2/day)