

INDUSTRIAL WASTE SURVEY
ESMOND MACHINE AND TOOL COMPANY
ESMOND, RHODE ISLAND

May 18, 1972

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At the request of the U. S. Attorney for Rhode Island and with the permission of Mr. Frank D'Angelo, company President, U. S. Environmental Protection Agency Region I personnel collected samples of the waste-water discharge of Esmond Machine and Tool Company to the Woonasquatucket River and the river itself on May 18, 1972. The objective of the study was to sample for a possible enforcement action against the company under Section 13 of the River and Harbor Act of 1899 (USC 33 §§407).

Esmond Machine and Tool Company

Mr. Frank D'Angelo, President of Esmond Machine and Tool Company, was interviewed by EPA Region I personnel on two occasions: May 11, 1972, during a reconnaissance survey, and May 18, 1972, the date of the sampling survey. These discussions concerned the nature of the production process and the constituents of the waste-water discharge to the Woonasquatucket River.

Esmond Machine and Tool Company produces handbag frames. The plant operates approximately ten hours per day, five days per week, with about seventy employees. Steel is used at the rate of from 15,000 to 19,000 pounds per week. The basic plating process consists of copper and nickel plating followed by a brass flash anodizing with zinc cyanide and copper cyanide in a water solution. (Figure 1 shows a schematic diagram of the plating process operation.) Approximately 100 pounds of copper cyanide and zinc cyanide powder are used per week. There are ten water rinse baths

PLATING PROCESS FLOW CHART

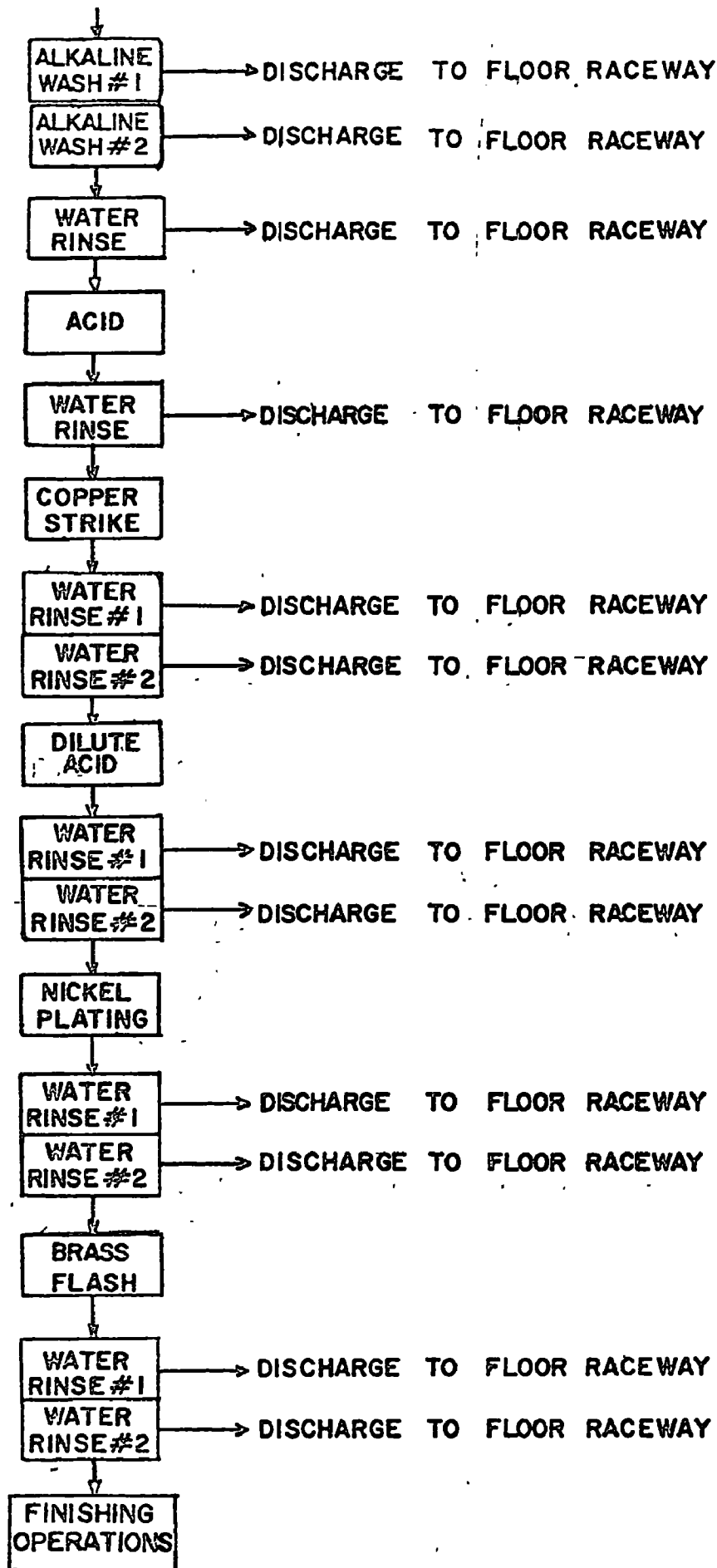


FIGURE 1

which produce a constant waste-water flow and two acid rinse baths which are dumped every six months. Also, two alkaline rinse baths are dumped periodically; one such dump occurred on the morning of May 18, 1972, the date of the sampling survey.

Dye studies performed on May 11, 1972 revealed that Esmond Machine and Tool Company ~~discharges its waste-water~~ through a ditch and concrete pipe to the Woonasquatucket River.

Waste water from various baths is collected in floor raceways and transmitted via a cast iron pipe to an earthen ditch approximately 250 feet from the building. The ditch extends for approximately 500 yards, at which point it empties into a swamp. The swamp is drained by a twenty-four inch concrete pipe which extends for approximately one mile where it empties onto the bank of the Woonasquatucket River. Both the ditch and the concrete pipe are on town-owned land. Neither the town nor Mr. D'Angelo know of any other tie-ins to this concrete pipe.

Sampling Information

The waste water from the plant was sampled at the discharge from the cast iron pipe (EMT 1), as the combined waste water and swamp runoff entered the twenty-four inch concrete pipe (EMT 2), and at the discharge of the twenty-four inch concrete pipe (EMT 3). Samples at these locations were taken approximately every fifteen minutes for one and a half hours and composited proportionate to flow. Also, grab samples were collected in the swamp (EMT 4), and in the Woonasquatucket River upstream of the discharge at Station W00 1 and downstream of the discharge at Station W00 2.

Most samples were collected, preserved, and analyzed according to EPA Standard Methods for the Examination of Water and Waste Water where applicable; the only exception being the preservation technique for those samples which were analyzed for total phosphorus. No chemical preservative was introduced to these samples because of the hazardous nature of the waste water (i.e., high cyanide concentration). The EPA Region I chain of custody record system was used to safeguard the samples. Analyses were performed at the New England Regional Laboratory in Needham, Massachusetts.

Figure 2 is a sketch of the general area showing all sampling locations. Photographs of the area including the dye study are shown in the Appendix.

Results

Table 2 summarizes the results of the laboratory analyses. Table 3 shows the loadings in pounds per day of the various constituents at the locations specified.

Based on the calculated discharge rate at Station EMT 1 of 125,000 gallons per ten-hour day and the measured effluent concentrations at the time of sampling, Esmond Machine and Tool Company discharged to the earthen ditch 6 pounds of cyanide, 86 pounds of nickel, 13 pounds of copper, 2.3 pounds of zinc, 0.3 pounds of phosphorus measured as total phosphorus, and 15.8 pounds of suspended solids measured as total nonfilterable residue.

This effluent, which has a highly variable constituency, is mixed with swamp drainage at the entrance to the twenty-four inch concrete pipe (Station EMT 2). The flow rate at this location was 276,000 gallons per

ten-hour day. Therefore, during the working day, swamp drainage contributes over one-half the volume to the flow in the concrete pipe.

Analyses of samples collected in the swamp itself (Station EMT 4) indicated that mixing with the effluent waste water occurs in this area. Concentrations of 1.0 milligrams per liter (mg/l) cyanide, 200 micrograms per liter (ug/l) nickel, 55 ug/l copper, and 48 ug/l zinc found in the swamp are above those which could be considered normal background levels. This admixture, along with a highly variable waste water constituency produced by the dumping of various process baths, created the following loadings at the entrance to the concrete pipe (EMT 2): 14.4 pounds of cyanide, 35.3 pounds of nickel, 6.4 pounds of copper, 1.5 pounds of zinc, 0.5 pounds of phosphorus measured as total phosphorus, and 240 pounds of suspended solids measured as total nonfilterable residue.

The combined waste water and swamp drainage flows in the concrete pipe for approximately one mile where it is discharged onto the bank of the Woonasquatucket River. This discharge created the following pollutional loadings on the river: 13.3 pounds of cyanide, 78 pounds of nickel, 14.7 pounds of copper, 0.5 pounds of zinc, 11.7 pounds of suspended solids measured as total nonfilterable residue, and 0.86 pounds of phosphorus measured as total phosphorus.

Mr. D'Angelo told a member of the sampling crew that two alkaline baths were dumped around 0900 hours. Between 0915 hours to 1100 hours, the pH of the plant effluent (Station EMT 1) varied from 11.5 to 6.0 S.U. Also, during the same interval, the color of the effluent changed from dark brown to almost clear (see photographs 17 - 20 of Appendix). This

dump is indicative of the variable constituency of the effluent. Such a change in pH can effect the solubility of the contaminants, thus their concentration in the waste. Due to this variability of the waste, the discharge loading rate at the outlet of the twenty-four inch concrete pipe differed from the influent to the pipe and the effluent from the plant.

Impact on Receiving Water

Between the Farnum Pike bridge and the old wooden dam, the Woonasquatucket River showed a marked increase in copper, zinc, nickel, and total phosphorus concentrations. This is the reach into which Esmond Machine and Tool Company discharges its wastewater.

Based upon analyses of samples collected at Station EMT 1, Esmond ~~Machine and Tool Company~~ discharged approximately 6 pounds per day of copper in the Woonasquatucket River increasing the concentration of copper in the river from 20 micrograms per liter (ug/l) upstream at sampling Station WOO 1 to 6800 ug/l downstream at sampling Station WOO 2. Concentrations as low as 20 ug/l adversely affect fish and other aquatic life. The toxicity of copper is increased markedly because of the synergistic effect produced by the presence of zinc.

Concentrations of zinc as low as 100 ug/l have been reported lethal to fish and other aquatic life. The concentration in the Woonasquatucket River downstream of Esmond Machine and Tool Company's discharge was 274 ug/l. Zinc exerts its toxic action by forming insoluble compounds with the mucous that covers the gills, by damage to the gill epithelium, or as an internal poison.

Nickel, which is also present in the Esmond Machine and Tool Company discharge, increased the concentration in the Woonasquatucket River from 12 ug/l above the discharge to 39,750 ug/l below the discharge. This concentration is over forty-five times the threshold concentration of 800 ug/l which is the lethal limit for some species of fish.

Esmond's waste water contained 0.27 milligrams per liter (mg/l) of phosphorus increasing the phosphorus concentration in the Woonasquatucket River from 0.04 mg/l upstream of the discharge to 0.30 mg/l downstream of the discharge. Phosphorus is an essential nutrient for the growth of aquatic organisms including algae. An overabundance or imbalance of this nutrient can lead to eutrophication of rivers and lakes.

Esmond Machine and Tool Company also discharged excessive amounts of cyanide to the Woonasquatucket River. Cyanide is highly toxic to both aquatic and human life.

TABLE 1
SAMPLE STATION IDENTIFICATION

Station	Latitude			Longitude			Description
	°	'	"	°	'	"	
EMT 1	41	52	31	71	30	25	discharge from cast iron pipe to ditch
EMT 2	41	52	35	71	30	27	entrance to 24" concrete pipe
EMT 3	41	52	44	71	30	11	discharge from 24" concrete pipe to Woonasquatucket River
EMT 4	41	52	36	71	30	30	upstream in swamp
WOO 1	41	52	49	71	30	10	Woonasquatucket River upstream at Farnum Pike Bridge
WOO 2	41	52	42	71	30	09	Woonasquatucket River downstream at old wooden dam

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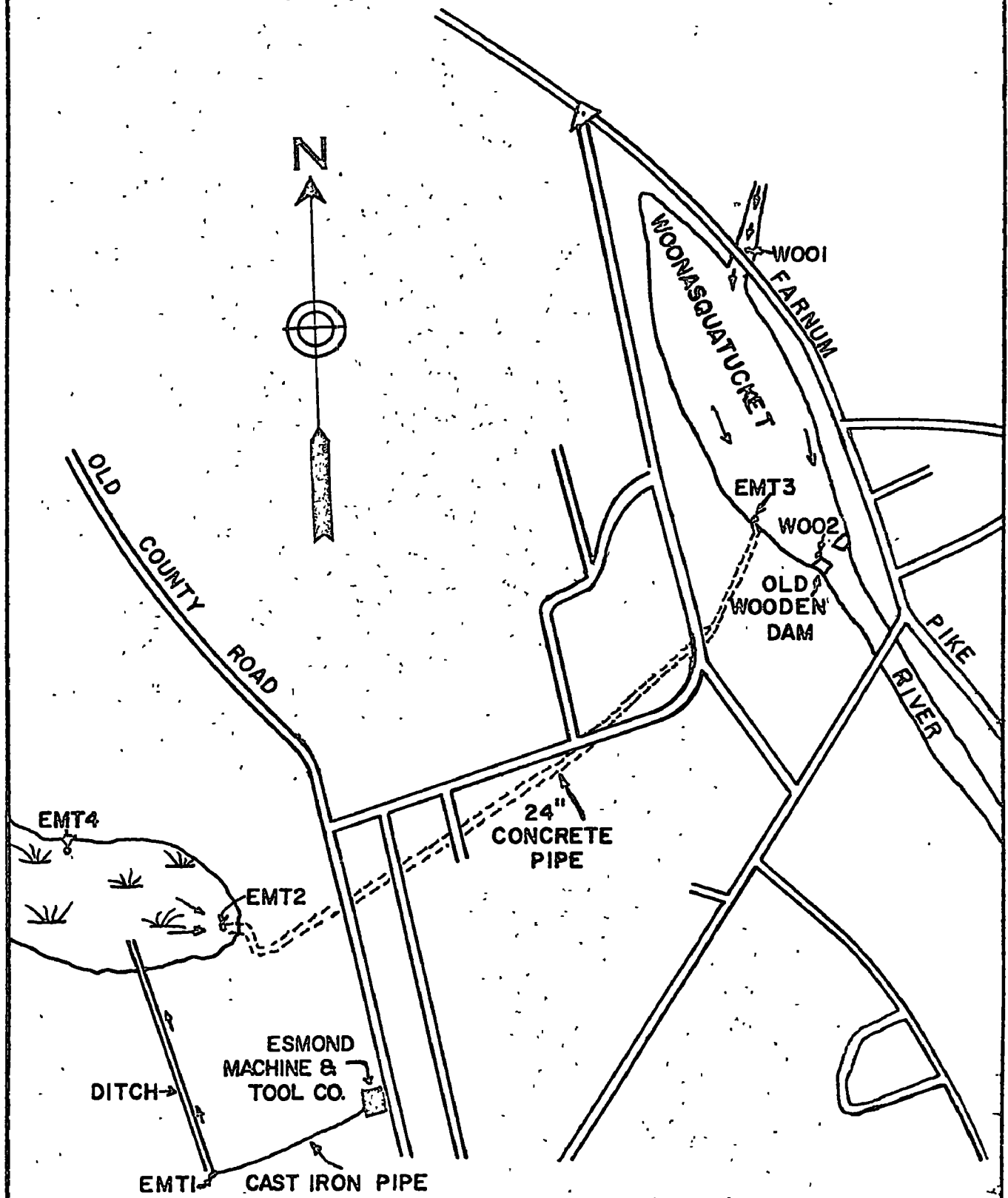


FIGURE 2

SAMPLE ANALYSES

Abbreviations and Units of Measure

<u>Analysis Reported</u>	<u>Description</u>	<u>Measured In</u>
Temp	temperature	degrees centigrade (°C)
pH	hydrogen ion concentration	standard units (S.U.)
Probe D.O.	dissolved oxygen	milligrams per liter (mg/l)
Total NFR	total suspended solids	(mg/l) .
Turbidity		Jackson Turbidity Units (J.T.U.)
Total P	total phosphorus	mg/l as phosphorus
Cyanide		mg/l as cyanide
Nickel		micrograms per liter (ug/l) as nickel
Zinc		ug/l as zinc
Copper		ug/l as copper

TABLE 1
ESMOND MACHINE & TOOL COMPANY
May 18, 1972
Laboratory Analyses

Station	Time	Lab Code	Depth (ft.)	Temp. (°C)	Probe D.O. (mg/l)	pH (S.U.)	Total NFR (mg/l)	Turbidity (J.T.U.)	Total P (mg/l)
EMT 1	Composite (0915-1100)	29790	1.0	15.0	10.0	*	15.5	9.0	0.27
EMT 2	Composite (0945-1130)	29791	1.0	17.0	11.0	**	105.5	50	0.24
EMT 3	Composite (1015-1115)	29792	1.0	15.0	10.5	-	5.1	2.5	0.38
EMT 4	1030	29793	1.0	18.0	9.1	5.0	11.6	1.5	0.02

River Stations

WOO 1	0925	29794	1.0	16.5	-	9.8	6.1	4.4	0.04
WOO 2	1040	29795	1.0	16.5	9.9	-	4.8	3.2	0.30

Station	Time	Lab Code	Cyanide (mg/l)	Nickel (ug/l)	Copper (ug/l)	Zinc (ug/l)
EMT 1	Composite	29790	5.8	82,500	12,500	2,250
EMT 2	Composite	29791	6.2	15,400	2,785	650
EMT 3	Composite	29792	5.8	34,000	6,400	230
EMT 4	1030	29793	1.0	200	55.0	48

River Stations

WOO 1	0925	29794	2.3	12	20.0	100
WOO 2	1040	29795	2.3	39,750	6,800	274

* pH ranged between 11.5 and 6.0

** pH ranged between 11.0 and 9.2

TABLE 3
ESMOND MACHINE AND TOOL COMPANY
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<u>Sampling Station</u>	<u>LOADING RATES</u>				<u>Suspended Solids (ppd)</u>	<u>Total Phosphorus (ppd)</u>	<u>Flow Rate (MGD)</u>
	<u>Cyanide (ppd)</u>	<u>Nickel (ppd)</u>	<u>Copper (ppd)</u>	<u>Zinc (ppd)</u>			
EMT 1 Discharge from plant	5.95	86	13	2.34	15.8	0.27	0.125
EMT 2 Combined Discharge and runoff going into 24" pipe	14.4	35.3	6.4	1.49	242	0.55	0.276
EMT 3 Discharge from 24" pipe to Woonasquatucket River	13.3	78	14.7	0.52	11.7	0.86	0.276
EMT 4 Swamp runoff mixed with waste water discharge	1.25	0.25	0.06	0.06	14.5	0.025	0.151*

Basis: Ten-hour day
ppd denotes pounds per day

*Calculated as the difference between flows measured at EMT 2 and EMT 1.

A P P E N D I X

PHOTOGRAPHS

May 11, 1972

- 1) discharge from cast iron pipe to ditch - sampling Station EMT 1
- 2) looking from Station EMT 1 at ditch downstream
- 3) confluence of ditch with swamp run-off
- 4) looking upstream at swamp run-off from Station EMT 2
- 5) confluence of ditch with swamp run-off - Station EMT 4 in lower right
- 6) Station EMT 2 - entrance to 24 inch concrete pipe
- 7) Station EMT 4 - note milky white color
- 8) dye study - dye entering swamp from ditch
- 9) dye mixed with swamp run-off showing backwashing phenomenon
- 10) dye entering concrete pipe
- 11) Station EMT 3 - dye flowing out of 24 inch concrete pipe
- 12) wastewater flowing down bank of Woonasquatucket River from 24 inch concrete pipe
- 13) looking upstream at Woonasquatucket River
- 14) Woonasquatucket River downstream at Station WOO 2 - showing dye dispersed in river
- 15) further downstream in Woonasquatucket River showing dye
- 16) Woonasquatucket River at old wooden dam - sampling Station WOO 2

May 18, 1972

Sampling Station EMT 1

- 17) 0915 - note dark brown color produced by alkaline dump
- 18) 0945 - sequence of sampling indicating a highly variable constituency
- 19) 1015 - " " " " " " "
- 20) 1045 - " " " " " " "